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**BUSINESS ADMINISTRATION
FOR ENGINEERS**

BUSINESS ADMINISTRATION FOR ENGINEERS

BY

C. FRANCIS HARDING, E.E., D. ENGR.

*Head of School of Electrical Engineering, Purdue University; Fellow
and Vice-president, American Institute of Electrical Engineers;
Member Society for the Promotion of Engineering Education;
Member District Delegatory Committee, Engineering Council for Professional Development*

AND

DONALD T. CANFIELD, M.S.E.E., E.E.

*Associate Professor of Electrical Engineering, Purdue University;
Member American Institute of Electrical Engineers; Member
Society for the Promotion of Engineering Education*

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PREFACE

"The engineer as the business executive of the future" is now a trite slogan. Thousands of industrialists and executives, associated with many types of industries and public utilities, have demonstrated the fact that the rigorous analytical training of the engineer is an excellent foundation for a business career.

Unfortunately the acquisition of basic business principles by the student of engineering has been left, in many instances, to the slow processes of experience, trial and error, and often financial loss after graduation. It has often been said, all too truly and demonstrated all too frequently, that the engineer is not sufficiently acquainted with business methods and corporate management to enable him to use his engineering training and experience most effectively. A course including such basic business principles, following the introduction to economics, should, in the opinion of many educators and experienced engineers, be incorporated in every engineering curriculum. Failing that, the young graduate engineer may acquire such training if it is provided in the analytical condensed form to which he is accustomed.

No single book nor small collection of books or periodicals has been found which covers this field comprehensively but concisely, although many highly specialized works have been written for the expert in each of the many branches of business and law which the successful engineering executive must know and absorb.

This book and its companion volume entitled "Legal and Ethical Phases of Engineering," by the same authors, have been prepared primarily to meet the needs of the engineering student or practicing engineer who desires to acquaint himself with the most important requirements of corporate management without undertaking an extensive business or legal training. It is the outgrowth of a course of lectures and class discussions administered and gradually developed by the authors with senior engineering students during the past twenty-five years.

Since the average engineer may be somewhat at a loss to present to nontechnical groups, both orally and in the form of written reports, the results of his precise engineering investigations, the problems, true and false questions, and particularly the general references listed at the end of most of the chapters may be used to excellent advantage for the presentation of class papers and debates.

Whereas practically all of the book is applicable to manufacturing, merchandising, and public utility corporations, the latter chapters are devoted more particularly to the peculiar problems arising in corporations engaged in public service. The large percentage of engineering graduates associated with such utilities justifies this limited degree of special application. Furthermore no apology is registered for the large number of electrical engineering problems and references used here for the reason that a rapidly increasing number of engineers of all branches are working on such problems; and for the further reason that most books upon similar subjects have overemphasized the civil and mechanical problems of the engineer.

It is hoped that young engineers, striving for recognition in connection with positions of responsibility, as well as those engineering students still engaged in their college training, may find these discussions of value not only as a textbook but as a permanent guide and reference. Instructors situated in positions similar to those of the authors may find the use of this book and its companion text of assistance in teaching the fundamentals of business, legal, and ethical relationships to engineering students in the limited time usually available for such instruction.

C. FRANCIS HARDING.
DONALD T. CANFIELD.

WEST LAFAYETTE, IND.,
September, 1937.

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BUSINESS ADMINISTRATION FOR ENGINEERS

INTRODUCTION

GENERAL CONCEPTION OF ENGINEERING

Engineering, as considered by the man of the street, has to do solely with machines, drawings, or instruments. In fact, the work of the engineering graduate is frequently confused, in the thought of the average person, with that of the engineman who operates a locomotive or the employee of an engine room of a power station or factory. Frequently he may be considered as an electrician, a draftsman, a laboratory worker, or a designer of intricate circuits or mechanisms. Indeed, the man who calls himself an engineer may be, in specific cases, any one of these representatives of industry or he may comprise them all in one individual. The graduate engineer of past years may have specialized in but one of these various branches of the engineering profession while the self-made man, with experience in a single line of endeavor, may have risen in numerous instances to the justifiable title of engineer. Sooner or later, however, if he is to broaden and advance to the full stature of the profession whose name he bears, he must take into account the economic phase of the problems with which he is working and, in addition, he must consider personal contacts, the needs and applications of his daily endeavor, and his productiveness to the world about him. Such a one, if successful, must have studied, either in school or in everyday practice, business relations with his fellows, both legal and economic; the value of the dollar, past, present, and future as expressed in materials, labor, and borrowed money; the personalities of human beings and how such affect their actions under varying conditions of business transactions; the methods of recording monetary values in their various forms; the possible legal protection of inventions; etc.

Much of the preparatory instruction in engineering has had to do with the exact sciences of mathematics, physics, and chemistry. Laboratory measurements have been precise. Errors in the fourth decimal place in such analyses may ruin not only a great project but the corporation that undertakes such a project and/or the individual who made the mistake.

To Lord Kelvin is attributed the saying: "When you can measure what you are speaking about and express it in numbers, you know something about it, and when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind. It may be the beginning of knowledge, but you have scarcely in your thought advanced to the stage of a science."

However, the so-called social sciences, or rather miscalled sciences, are not and probably never will be that precise. Yet the individual layman, the executive, and the engineer must deal with such. The world wants to know what it all costs before you and I may have the benefit of new scientific developments. The common denominator of the world is the dollar; and the English language, either oral or written, is the common medium of communication from the precision laboratory to the desk of the president, from the exact specifications of the engineer to the purchaser of the new product, and from the engineer to the stockholder of the new corporation which may have been established to bridge the gulfs between invention, usefulness, and financial success.

Of little ultimate value, therefore, is the scientific analysis without this medium of exchange. Hence the insistence of engineering schools upon adequate ability, on the part of the prospective engineer, to speak and to write the English language concisely and convincingly and upon his adequate knowledge of the analysis of values expressed in dollars and cents, approximate though they may be.

The most familiar and most widely accepted definition of engineering is the following, which was expressed by Tredgold nearly a century ago:¹ "Engineering is the art of directing the great sources of power in nature for the use and convenience of man." A modification of this definition has been proposed by the late H. G. Stott: "Engineering is the art of organizing and directing men and of controlling the forces and materials of

nature for the benefit of the human race." Objections have been made to Tredgold's definition that it comprises too much and defines too little; it does not include the human element. Under these definitions many who are not considered to be engineers may direct "the use and convenience of man" and "the great sources of power in nature." Thus the farmer who plants his seed directs the power of the sunlight to its germination and growth and so in a general way might be included in these definitions. On the other hand, the art of directing the sources of power does not constitute the entire essence of engineering. Engineering has taken on the added meaning of directing *in a certain way* and involves something more than the production of the result. It has come to mean more than the mere application of physical laws to obtain some kind of a result. It means obtaining, relatively, the best possible, including the most economical, result. The construction of a clumsy and inefficient machine or structure by one who knows little or nothing regarding the principles and laws involved, would not be called engineering. Another excellent definition has been proposed, therefore, to cover the idea as outlined above. "Engineering is the conscious application of science to the problems of economic production."

Engineering is primarily associated with production. It may be the production of a new structure or a new machine, a railway, a factory, or a mine; or, again, it may be the production of a commodity, of a manufactured product, or of a service. The problems of production deal with the direction and control, not only of forces and materials, but of men. It was a recognition of this fact that caused Stott's modification of Tredgold's definition. The qualification "economic" attached to the word "production" adds another element to the definition. Engineering must take into account the economic side of production. It is safe to state that no engineering problem is entirely without its economic features. Even in military engineering, where cost in dollars may frequently be a secondary consideration, there is an economic side arising from the necessity of making the means provided fit into the necessities of the case in the best possible manner. In civil engineering (using the term in a broad sense, as contrasted with military engineering and, therefore, including mechanical, hydraulic, sanitary, railway, electrical, chemical,

mining, and all other divisions), there is hardly a single problem that does not involve the economic question.

To illustrate the statement just made, a drainage or irrigation ditch can be justified only when its construction will produce a sufficient increase in the productiveness of adjacent land. A sewer or a public water system should be installed only when the improvement of public health and comfort will warrant the expenditure. A street lighting system can be economically "proved in" only when there is sufficient improvement in safety and comfort of night travel. In fact, the economics of the case must enter into the solution of every engineering problem, whether it be the selection of a brick or a wooden building, a simple or a condensing steam turbine plant, a manual or an automatic telephone system, an 8-in. or a 10-in. water main, or whatever the problem may be. The solution may be a very simple one which can be determined purely on the basis of cost, as, for instance, whether a small amount of earth is to be handled by wheelbarrows or by scrapers. On the other hand, the problem may be very complex, involving questions of first cost of plant, life of plant and equipment, cost of production, market for a commodity or a service, supply of raw material, interest and financing costs, operating expenses, and many other things. Such a problem might be the construction of a new railway or the installation of a new steam or hydroelectric plant, a factory, or any other large project. It is a composite of a large number of smaller problems of engineering selection.

After the general question of advisability of proceeding with the project has been decided affirmatively, the detailed questions remain to be solved. In the case of a factory, for instance, there is the question of location, involving the choice between different sites and the weighing of possible advantages in respect to supply of raw material, proximity of the market, labor supply, power available, etc. Then comes the question of securing suitable living quarters, whether by building or leasing, the selection of different types of machines, the best type of machine drive, the proper location of machines to secure economical handling of work in process through the shop, the handling and shipping facilities, etc. In fact, every detail of the construction and the operation of the plant involves some sort of balancing between the advantages of alternative methods. In many cases the

decision can be made on the basis of cost in dollars and cents in the long run, while in other cases there are so-called intangible considerations which cannot be measured in terms of money but which must be given attention in making the final choice.

It is the engineer's problem to examine the alternative methods from a scientific viewpoint and to make his decision on the basis of the advantages and disadvantages discovered. The term "engineering judgment" has been applied to the judgment based on an engineering method of selection. Engineering judgment is not inherently different from judgment of any other kind. The accidental difference lies in the procedure in arriving at such judgment. The engineer collects, analyzes, sorts, and coordinates data relating to the matter under consideration and applies to these data general scientific principles. Reasoning from the analytical data, he draws conclusions and forms his judgment. It is something more than an expert or an intuitive guess.

An engineering problem, like any other problem, requires analysis before its solution is attempted. The first step is the forming of a clear conception of the final result to be obtained. This is an extremely important matter and the forming of such a conception requires a considerable amount of constructive imagination. No great work has ever been accomplished unless it had its first being in someone's imagination. This does not mean that imagination should run riot and create all sorts of fanciful things. On the contrary, it means an imagination constantly checked and restrained by good judgment and common sense. A clear mental picture of the desired result constantly kept before the engineer during his work on a problem will save much time, will unify the work, and will result in a generally improved class of work. After the mental picture has been formed, a study should be made of the various methods of achieving the desired results. This may involve the collection of data, the preparation of tentative plans of procedure, the making of surveys, tests, and studies of various kinds. As the work proceeds, it gradually becomes apparent that certain lines of advance are impracticable and the decision narrows down to a comparatively small number of alternatives. These alternative plans must be developed to such a point that it becomes apparent that one possesses sufficient advantages over all others to warrant its selection.

In the course of the preparation of data and alternative plans, it will be obvious that there are two general classes of factors that will enter into the solution: those which may be evaluated numerically in terms of dollars and cents and those which are not susceptible to such valuation. The factors in the first class are such elements as (1) first cost, (2) interest charges, (3) maintenance cost, (4) depreciation, (5) operating expense, (6) income and similar items. All or only part of these may enter into a given problem. In the second class are such things as risk, possible change of requirements or operating methods, growth, public policy, and expediency. Neglecting these latter factors, the best engineering plan is the one that will produce the most economical result in the long run. However, in many problems the weight of some of these factors which cannot be evaluated may be so great as to overcome a small advantage from a monetary standpoint. Unless the weight of one or more of these factors is sufficiently great to exclude all plans but one, a study of various plans should be made from a cost standpoint and the advantage of cost should be balanced against other advantages.

Since the various cost factors must be determined in advance of construction, they will necessarily be based upon estimates. The making of cost estimates will be taken up in greater detail at a later time and references will be made here only to possible sources of information. Information of a statistical nature may be found in government reports such as those of the Bureau of Census and the Department of Commerce, in reports of State Public Utility Commissions, and in other published reports and compilations of data. Cost and other similar data may be found in handbooks of published cost data, in papers presented before engineering societies, and in the technical press. Most concerns that maintain an engineering department have cost records on past work and information can also be secured from book records and vouchers on past work. Time studies and past experience may serve as sources of information along this line.

As the student becomes better acquainted with what is meant by the term "engineering," he gets a clearer conception of the multitude of facts and conditions that enter into the work of the engineer. As the untrained man begins to realize the scope of the engineering profession, he is very prone to magnify its difficulties and its responsibilities. He may, in a manner, regard

the engineer as a type of superman. He realizes that engineering involves more than a craftsman's work. He soon learns that the wide scope of the profession is made up of a number of smaller problems and tasks; that the great construction work is, through proper organization, a composite of many small jobs and economic surveys or estimates. Later, however, in the process of his adequate education and experience, he loses his fear of the bigness of the work and undertakes each element of study or experience by itself, and gradually weaves it into a complete entity known as "engineering training."

The one prominent factor that differentiates the engineer from the boss or supervisor is the breadth of vision which enables the former to grasp the interrelationship that exists between the integral parts and phases of the combined project. One boss or foreman may supervise the preparation of the roadbed of the prospective railroad, another may build the track, and still another may install the distribution or signal system, but no one of these specialists grasps the economic and traffic interconnections between these several subdivisions of railroad construction. The broad-minded and experienced engineer sees that the roadbed must have certain limits enforced if the train is to run safely and economically when the railroad is complete. He not only acts as a master cabinetmaker, joining together the various parts in proper relationship with one another, but he plans the size and cost of the entire structure to meet existing and future needs and proceeds to operate the organization after its completion with the maximum possible efficiency and economy.

CHAPTER I

ENGINEERING ECONOMICS

For a long time the executive and business phases of engineering were left to the businessman with little or no engineering training. He was a specialist in his line. The management of manufacturing and engineering projects, therefore, was thought to be his work and his alone. The engineer disdained the idea of considering the financial, sales, and managerial fields as worthy of his training. The time came, however, when the average businessman did not understand the technical engineering problems with sufficient clarity to enable him properly to administer the affairs of a technical business. It was found to be easier for the trained engineer to grasp the business side of the enterprise than it was for the businessman to learn the rather involved and mathematical intricacies of engineering. Consequently more and more emphasis is being placed upon the necessity for the student of engineering to know something of the economic and legal aspects of the engineering profession. Business engineering therefore, if such a coined phrase may be used for the happy blending of technical engineering ability with a keen business sagacity, has become a very popular and profitable field. The man who can plan, construct, and make an engineering undertaking yield a substantial and legitimate profit over a period of years is a greater asset to the community than is the one who designs only the actual technical features of an enterprise.

This conception of the place of business in engineering and of the place of engineering in business has added materially to the prominence and breadth of the engineering profession. It provides a broader field for the engineer and is proving a successful economic innovation. It has caused a demand for more knowledge of economic principles and their application to engineering.

Investment.—Engineering economics really involves the study of investments in the broadest sense of that term. Such invest-

ment is usually thought of as a certain amount of money to be expended at one time for a single definite purpose. More generally considered, however, it includes the values invested in materials, labor, and even the operating expenses of industry, all of which, if wisely expended, will provide an adequate yield as the result of their investment.

The most common problem presented to the engineer is, therefore, "Will this investment pay?" or "Will this investment represent a wise policy?" Insofar as the investment may be estimated in dollars and cents and to the extent that the yield theorem may be adequately and concretely expressed in monetary values, the problem is easily stated. Its solution involves the simple process of comparing two or more definite figures.

For example, the relative merits are easily determined for the investment of \$50,000 or \$60,000 in one of two available factory buildings of similar size and construction, both with adequate location and state of preservation for the proposed manufacturing business. Values of the physical property alone are involved. These are readily estimated as a result of an inspection and measurement of the two buildings. For a given type of building construction, several methods of checking the accuracy of estimated values are available:

1. A comparison of the estimated value with that of another similar structure in the same locality may be made by one familiar with real estate.
2. The values of two similar structures may be compared upon the unit basis of cost per cubic foot of volume or per square foot of floor area.
3. Relatively large and definite portions of the two buildings which are directly comparable, such as brickwork, millwork, etc., may be checked by means of detailed cost estimates. The values of the buildings may then be calculated by the proportion of the parts of known cost of the total cost.
4. Detailed estimates may be made of all labor, material, and incidental costs entering into the two structures.

As in practically all such comparisons, the more nearly accurate methods involve the greater time and expense in preparation. One must decide what degree of accuracy is desired and how much time and money can be legitimately expended in securing the valuation in question.

Kelvin's Law of Economic Selection.—Second in the order of simplicity of consideration in engineering economics is the determination of values of one or more comparable investments wherein operating costs throughout the year must be taken into account. Such is the problem most frequently presented to the engineer. It is simply the broad application of Kelvin's law. It states that the best investment from a purely economic standpoint, i.e., neglecting for this consideration all allied intangible values in making the selection, is the one for which total annual expenses are a minimum or, in special cases, where "*the annual operating expense is equal to the annual fixed charges upon the investment.*"

For example, in making a selection of the most economical machine, cable, building, pole line, etc., it usually happens that several sizes, types, or qualities of material and workmanship are available for a choice. If correctly priced, it is usually the case that those more expensive in first cost either will render better or longer service or will provide equivalent service at a lower annual operating expense. How frequently is the comparable statement heard, even in the purchase of some small article in a retail store, "Well, this costs more, but it will give better service than the other!" Fundamentally speaking, this is a simple, frank statement of Kelvin's law.

Suppose, by way of illustration, the value of which the engineer will readily recognize, a railroad company which has been paying watchmen at a highway crossing \$1,800 a year considers the possibility of grade separation or some form of automatic signal, either one of which will do away with the expense of the watchmen. Considering the pay roll of this operating cost a continuous probability otherwise, it will be shown in a later chapter that an initial investment of $\$1,800/0.06$ or $\$30,000$ might be justified for the replacement from the purely economic standpoint. In other words, the operating expense of the present system has been equated to the fixed charges of the new installation, if money can be borrowed at 6 per cent. Many other advantages will immediately appear which must also be given careful consideration, such as the additional safety that may result from the elimination of the possible negligence or illness of the watchmen, etc.

Or consider the installation of an automatic substation for furnishing electric light and power, electric railway service, or

even hydroelectric power from or to small distant localities. The elimination of the pay-roll expense per annum of operators may be equated to the sum resulting from the fixed charges upon the substitute investment. The automatic telephone exchange, with the present well-recognized dialing features, represents another example of such a study.

Wherever new operating expenses of a lesser magnitude are introduced, the difference between present and proposed operating expenses would, of course, be the annual amount thus equated to the fixed charges on the new investment. The determination of many such items is further outlined in Chaps. XXI and XXII.

Intangible Values.--Immediately upon the determination of the purely physical or tangible values, a host of intangible considerations arises, each with its own possible economic value, more or less difficult of determination. Even these are thus far quite independent of the yield to be derived from the investment, except insofar as they vary gross revenue and their new operating expenses. Both of these latter items will be considered at greater length later, although it may now be foreseen that such improvements may in themselves and apart from any inherent economic saving so improve or safeguard the service as to provide greater patronage thereof, which in turn will frequently increase the gross revenue resulting therefrom.

In the determination of proper value for an investment in a factory, merchandising or contracting business, power station, or public utility system, most of the following intangible items must be recognized and some value placed upon each in weighing the economic evidence of the problem. In many instances such values are the results of trained judgment based upon past experience with a similar undertaking.

TABLE I

I. Primary considerations. Investment considerations.

A. Type and size of organization.

1. Proprietorship.
2. Partnership.
3. Corporation.
 - a. Private.
 - b. Public.
 - c. Public service.

- B.** Capital involved.
 - 1. Amount.
 - 2. Form.
 - a. Cash.
 - b. Stocks and bonds.
 - c. Notes.
 - d. Mortgages available.
- C.** Labor available.
 - 1. Supply.
 - 2. Character.
 - 3. Price.
 - 4. Living conditions.
 - 5. Living cost.
 - 6. Specialized training.
 - 7. Unemployment.
 - 8. Union affiliation.
- D.** Raw material market.
 - 1. Supply (quality and quantity).
 - 2. Transportation.
 - 3. Cost.
- E.** Power supply.
 - 1. Availability.
 - 2. Continuity.
 - 3. Cost.
 - 4. Necessity for reserve private power supply.
- F.** Consumers market.
 - 1. Distance from center of demand.
 - 2. Transportation.
 - 3. Special nature.
 - 4. Competition.

II. Secondary considerations.

- A.** Utilization of waste products.
 - 1. Possibility of disposal.
 - 2. Cost of disposal.
 - 3. Market value.
- B.** Freight rates.
 - 1. Raw material.
 - 2. Finished product.
- C.** Civil control (legislation and regulation).
 - 1. State.
 - a. Corporation laws.
 - b. Taxes.
 - c. Employer's liability acts.
 - d. Commission regulation of public utilities.
 - 2. Municipal.
 - a. Ordinances.
 - b. Taxes.
 - c. Inspection.
 - d. Public sentiment.

D. Banking facilities.

1. Adequacy of funds.
2. Credit available.
3. Financial advice.
4. General utility.

E. Real estate.

1. Location in city, suburb, or country.
2. Cost.
3. Taxes and improvement assessments.
4. Insurance.
5. Character of soil.
6. Natural hazards.
7. Cost of preparing site.

F. Building plans.

1. Values of corresponding buildings.
2. Estimates of costs.
3. Materials.
4. Labor.
5. Life and probable depreciation.

Yield.—After all, the most important purpose of investment is to secure an adequate yield. This word has, in many instances, been loosely applied to gross revenue, the various portions of gross revenue after operating expenses and interest charges have been deducted, and to net income. The latter, i.e., the net return to the investor, expressed either in dollars or in per cent of investment, will be considered as *yield* and *percentage yield*, respectively, throughout this book.

The natural question always asked when considering an investment is, "What will it yield?" In other words, the investor wishes to know as accurately as possible what net return in dollars per annum he will receive for the use of his invested money.

Interest.—In the most simple form of investment in the savings bank, this yield is a definite amount, figured as a percentage of the principal invested and is called simple interest. If allowed to accumulate, and if the yield is expressed as a percentage of the accumulation of the combined amount of principal and simple interest, the process involves compound interest. The details of such yields are outlined in Chaps. XIII, XIV, XV, XXI, and XXII.

For example, if a person has \$10,000 loaned as an investment at 6 per cent simple interest, he will, of course, expect and claim a yield of \$600 per annum for the use of his money. If, however, he allows the interest at the same rate to be compounded for ten years, he will receive at the end of that period \$7,910 for the

interest instead of the $10 \times \$600 = \$6,000$ which would have resulted from ten years' collection of the simple interest. Similarly, in twelve years at this rate the yield will have more than equalled the principal invested at compound interest at 6 per cent, or, in other words, his investment will have doubled in value.

Many other forms of yield, such as interest on notes and bonds, dividends on preferred stocks, etc., may be directly and accurately predetermined for future years and are usually depended upon as a definite income if the principal is held intact. Obviously such interest, which is conservative and entirely dependable, represents, generally speaking, the lowest percentage yield upon the money invested.

Insurance.—Similarly, money may be invested in insurance, a portion or all of which investment may be used up annually to pay for protection to life or property. With many types of annuity or endowment insurance, however, the yield may take the form of annual or lump-sum payments to the insured or his beneficiaries at a definite future date.

Assuming that one is paying a certain amount annually upon an endowment insurance policy such that at the end of twenty years the company will pay the insured \$10,000, such a sum might provide as a gross annuity the amount of \$1,359 per year over a period of ten years if interest is figured at 6 per cent. It is evident that without the calculation of compound interest, which the insurance company pays for the use of a decreasing portion of the \$10,000, the annual gross revenue would have been only $\$10,000/10 = \$1,000$ per year. Of course, the expenses and profits of the insurance company must be deducted before the yield to the investor is determinable. Such calculations are readily made by the use of Table XXVI of Chap. XIV.

Rent.—Money invested in real estate which is used by a tenant returns a yield in the form of monthly rent or as an annual or long-term lease.

As an example of an investment involving rent, none more simple can be studied than the problem frequently presented to the individual of owning one's home in contrast to the rental of a house or apartment. Compare the annual cost of a residence for which you pay \$10,000 (case A) with the rental of a corresponding house at \$100 per month (case B).

If the conditions thus assumed are correct for a particular home, the question arises as to whether or not the many intangible advantages of owning one's own home will balance the \$110 per annum extra that is involved in case A. Such a decision is obviously one of personal opinion and judgment. A satisfactory solution is more likely to be reached, however, if the values that can be accurately calculated are first determined as outlined in Table II.

TABLE II.—COMPARATIVE INVESTMENTS

Investment of \$10,000	Annual charge	
	Case A	Case B
Fixed charges:		
Interest at 6 per cent.....	\$ 600	
Taxes, on 80 per cent valuation, at 2 per cent.....	160	
Insurance, 0.5 per cent.....	50	
Depreciation and repairs, at 5 per cent..	500	
	\$1,310	
Rent.....	.....	\$1,200

Dividends.—If shares of stocks are purchased in some corporation, as explained in Chaps. III and IV, the yield to the investor assumes the form of dividends, paid quarterly, semiannually, or annually as a percentage return based upon the par value of the stock. Such dividends may be variable in amount, determined from one period to another in the case of common stock by the directors of the corporation. They are supposed to represent the earnings or yield of the stockholders' (the owners') investment but actually they depend upon the success of the business in which the money is invested.

Suppose one invests in 100 shares of stock in a corporation, each having a par value of \$100; his total investment is \$10,000.00. Most forms of preferred stock have a definite dividend rate, for example, 7 per cent on the par value. Such an investor will, of course, expect a yield of \$700 per annum from such an investment. This is therefore similar to a simple interest payment. If he were fortunate enough to have purchased the stock

at a discount, say, at \$95 per share, the percentage dividend still applies to the par value, so that the yield is still \$700, which now represents 7.38 per cent yield instead of 7 per cent upon his actual cash investment.

In the case of other forms of shares of stock such as are described in Chap. III and particularly in the case of common stock upon which the directors may or may not declare a dividend each year, the yield, although sometimes very large, is at least variable and may be very small or nothing at all over a period of many years.

Since such yields are dependent upon all the operating functions of the business throughout the year, or cycles of years, they involve indirectly all factors influencing the gross revenue, operating expenses, and fixed charges of the business in question. They can be analyzed in detail, therefore, only after a study has been made of the possible types of organization, the methods of financing such organizations, and the factors affecting the success of everyday business transactions. However, with the assumptions of the investments and operating conditions outlined in the following problems, practice in selection of investments will be possible pending a more detailed study in subsequent chapters of the operating conditions necessary to make sound the premises assumed in these illustrations.

Review Problems

1. Distinguish between engineering economics and classical economics.
2. What are the factors that have caused engineering to encroach more and more upon the field formally called business?
3. Why is it more important today for an engineer to be well grounded in the fundamentals of economics than it was twenty-five or fifty years ago?

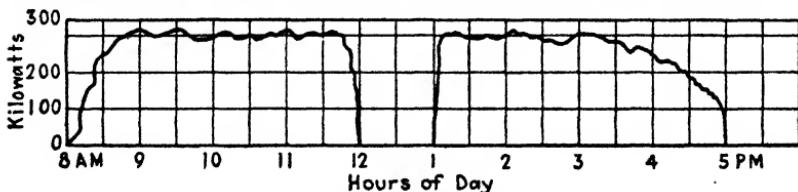


FIG. 1.— Load curve of a factory.

4. Because the engineer who caused the record shown in Fig. 1 to be taken was more than just a technical expert, he was able to save the company involved \$250,000 a year. Can you suggest what he did?
5. What are the advantages and disadvantages, both economic and intangible, of the following:

- a. Purchase a house for \$5,000 upon which it is necessary to pay interest of 6 per cent, insurance 1 per cent, taxes 3 per cent, and depreciation 5 per cent.
- b. Rent an apartment for \$600 a year.
6. Assuming an automobile is needed for 5,000 mi. per year, list the economic and intangible advantages and disadvantages of each of the following:
 - a. Own an automobile that costs \$1,500 upon which the annual charges are: interest 6 per cent, depreciation $16\frac{2}{3}$ per cent, insurance 4 per cent, taxes 2 per cent, maintenance and repairs \$25 a month, tires replaced every 10,000 mi. at \$100.
 - b. Hire a taxi or pay bus or carfare for all automobile needs at an average of 10 cts. per mile.
7. In equipping a house you are now building you are attempting to decide between heating with gas purchased from the local service company and an automatic stoker and coal. List the items that might help you in arriving at a decision.
8. You are considering installing air-conditioning equipment in your house. Outline in detail the information you would require in order to make an intelligent choice of the systems available.
9. A town is considering the building of a municipal power station for street lighting and water pumping at a cost of \$200,000. With such a plant interest is 5 per cent, depreciation 8 per cent, insurance 1 per cent, and operation and maintenance \$25,000 per year. The energy required, which averages 4,000,000 kw.-hr. per year, may be purchased for 1.2 cts. per kilowatt-hour from a public service corporation. As a citizen of this community and a taxpayer, would you favor the building of the municipal power station? Why?
10. List in detail the items that should be considered before you undertake the manufacture of a new device you have just invented and upon which you hold all patent rights.

CHAPTER II

PROPRIETORSHIP, PARTNERSHIP, AND CORPORATION

The student of today who is to be the employee or executive of a corporation tomorrow, whether he is a graduate in engineering, arts, science, or law, will do well to ponder over the following most significant remarks of the president of Columbia University:

I weigh my words when I say that, in my judgment, the limited liability corporation is the greatest single discovery of modern times, whether you judge it by its social, by its ethical, by its industrial, or in the long run—after we understand it and know how to use it—by its political effects. Even steam and electricity are far less important than the limited liability corporation, and *they* would be reduced to comparative impotence without *it*.¹

To test this statement, try to imagine our present financial and industrial status with electricity, steam, the gas engine, and radio but without the modern corporation.

Practically all important forms of business and commercial enterprise can be classified into three groups. Such groups are listed in the chronological order in which they were developed:

1. The proprietorship or individual enterprise.
2. The partnership.
3. The corporation.

These three forms of business organization will probably be rated as of present-day importance in the reverse order; the corporation easily ranking first.

Proprietorship or Individual Enterprise.—The oldest and simplest form of business, which, as the name implies, is formed and controlled by one person, is frequently known as a proprietorship. Obviously of some minor advantage in small business undertakings, it is so simple in form that it will not enter further into this consideration.

The Partnership.—The form of business next developed was the partnership. Herein, two or more individuals band them-

selves together to promote, finance, and conduct an enterprise for their mutual benefit.

A partnership may be defined as a legal relation existing between two or more persons who have agreed, either expressly or impliedly, to combine as principals their *property*, *labor*, or *skill* in carrying on a lawful business for their joint profit.

It should be noted that each partner agrees to contribute or invest a specified amount of property, money, labor, or skill in the enterprise to be carried on in their name.

A typical form of such a partnership agreement follows:

FORM OF PARTNERSHIP AGREEMENT

This agreement entered into this _____ day of _____, 19____, by and between *A* and *B*, both of Lafayette, Indiana.

Witnesseth:

1. The parties hereby agree to become co-partners under the firm name of *A* and *B*, with principal offices and place of business at Lafayette, Indiana.

2. That the business of the partnership shall be the manufacture of electrical wiring specialties.

3. That *A* shall contribute \$25,000 to the business of the partnership, which shall be paid by the _____ day of _____, 19____, and *B* shall contribute \$15,000 and the shop machinery, supplies, and raw materials owned by him, to be paid and delivered by the _____ day of _____, 19____.

4. That the partnership shall commence on the _____ day of _____, 19____, and shall continue _____ years, unless sooner dissolved by death, bankruptcy, insolvency, or disability of either of the parties hereto, or unless terminated under the provisions hereof.

5. That *A* and *B* shall both devote all their time, skill, and attention to the business.

6. That *A* and *B* shall, at the end of each month, draw one-half of the excess over \$50,000 from the partnership funds.

7. That either partner may at any time after the _____ day of _____, dissolve said partnership by written notice of his intention to do so, delivered to the other partner, and the partnership shall be dissolved at the expiration of _____ days after the giving of said notice.

8. That at the dissolution or termination of such partnership, an inventory and appraisal of all partnership assets shall be made. After payment of all partnership debts the balance of the assets shall be divided equally between *A* and *B*.

In witness whereof, the parties hereto have set their hands in duplicate the day and year above written.

(Signed) *A*.

(Signed) *B*.

By an agreement, similar in form to this, each member of the partnership binds himself, to the full extent of his private assets, to pay all obligations incurred by his partners or himself in the name of the firm.

The net profits of a partnership are distributed among the several partners either in proportion to their original investment or in some other definitely predetermined ratio. Such profits may, at the will of the partners, be reinvested in the business.

Partners do not necessarily take an equally active part in the management of the business. One or more, often characterized as the "silent partner," may assist in financing the business and may receive his proportion of the profits without entering into or even becoming acquainted with the technicalities of the enterprise. Any act of his, however, carried out in the name of the partnership, will bind, financially and legally, the other partners.

It will be readily seen that, for relatively small and more or less private business enterprises, the partnership form of organization may have distinct advantages. The capital invested and the policies of the business are confined to a few individuals and, in many instances, in which the partners are men of influence and means in a community, the credit that may be secured by such a partnership is superior to that of any other form of organization. This is particularly true during the period in which a business is being established.

The partnership is not looked upon as a legal being, but each partner, as an individual, may sue or be sued. Upon the death of a partner, or the transfer of his interest, the partnership is terminated. The partnership therefore, from the legal standpoint, must necessarily be considered a personal and more or less temporary organization.

However, from the commercial standpoint, the partnership is recognized as an entity in itself quite apart from its individual members. Orders are taken from and invoices billed to the firm name and the firm is considered the source of revenue for the wholesale merchant.

In commenting upon his rather unusual distinction between legal and commercial aspects of the partnership, Justice Lindley has well summarized the situation as follows:

Commercial men and accountants are apt to look upon a firm in the light in which lawyers look upon a corporation, i.e., as a body distinct from the members composing it, and having rights and obligations distinct from those of its members. Hence, in keeping partnership accounts, the firm is made debtor to each partner for what he brings into the common stock, and each partner is made debtor to the firm for all that he takes out of that stock. In the mercantile view, partners are never indebted to each other in respect to partnership transactions, but are always either debtors to or creditors of the firm. . . . The partners are the agents and sureties of the firm; its agents for the transaction of its business; its sureties for the liquidation of its liabilities so far as the assets of the firm are insufficient to meet them. The liabilities of the firm are regarded as the liabilities of the partners only in case they cannot be met by the firm and discharged out of its assets. But this is not the legal notion of a firm. The firm is not recognized by lawyers as distinct from the members composing it.²

As business enterprises began to take on large proportions, and particularly as demands for public service appeared in rapidly growing cities, there developed an imperative need for some form of business organization other than the individual enterprise and the partnership. More capital was required than could be obtained from or by a few individuals. People in general were becoming more interested in these matters and desired to invest small amounts of capital. The result of these demands was the third form of business enterprise, the corporation.

There is still, however, a very definite place for the individual enterprise and the partnership. In fact, a study of the signs over the doors of business establishments of the average small city discloses almost as many firm names such as "The Brown Shoe Store" or "Brown and Metcalf" as there are corporate names such as "The Brown-Metcalf Co." or "The Winton Light and Power Co."

The Corporation.—The corporation has been variously defined. Chief Justice Marshall of the United States Supreme Court over a century ago defined the corporation in the following terms which can hardly be improved:³ "A corporation is an artificial being, invisible, intangible, and existing only in contemplation of law." This definition, although couched in legal form, indicates that the corporation is not a natural person or group of individuals but rather a separate legal entity. A

later definition, established by the same court, defines a corporation as: "An association of individuals united for some common purpose, and permitted by the law to use a common name, and to change its members without dissolution of the association." Possibly however, the following more freely worded description of what is meant by the term "corporation," quoted from the same authority, may be of greater value to the reader in grasping a mental picture of this rather intangible being.

"A corporation is an artificial person created by law as the representative of those persons, natural or artificial, who contribute to, or become holders of shares in the property entrusted to it for a common purpose. It is the creature of positive law, its rights, powers, and duties are prescribed by the law."

The modern corporation, as the name implies, usually results from the cooperation of many interested parties. Such interested persons, usually in a position to obtain considerable capital, meet and decide to become incorporators of a new corporation. Articles of incorporation are drawn up which should set forth the following information regarding the proposed business:

1. Proposed name for the corporation.
2. Business transactions it is desired to undertake.
3. Names and addresses of incorporators and obligations of each.
4. Proposed officers, directors, and method of election.
5. Names and addresses of directors for first year.
6. Capital desired.
7. Number of and kinds of shares of stock and value of each.
8. Bonds proposed for borrowed capital.
9. States in which business is to be undertaken.
10. State in which business is to be incorporated.
11. Duration. (This may be perpetual in some states.)

These important features which should be included in proposed articles of incorporation are effectively illustrated in the forms found in Appendix A. These are forwarded to the Secretary of State of the state in which incorporation is desired. In some states a commissioner of corporations acts in such a capacity.

The state in which incorporation is desired and applied for is not necessarily that in which the incorporators live nor the one in which the business is to be wholly or partially transacted. The requirements prescribed and the privileges offered by the various

states are found to vary widely. These requirements should be carefully studied in advance in order that desired corporate activities may be undertaken with adequate protection and at reasonable cost.

The general advantages of the corporate form of organization over a partnership may be briefly listed as follows:

1. Larger capital secured more readily.
2. Responsibility distributed more widely over many investors.
3. Financial obligation (in most states) limited to investment in stocks.
4. Management shared by more officers.
5. Functions more clearly defined by law.
6. Finances more carefully restricted by the state, particularly in public service corporations.
7. Perpetual existence, without regard to the lives of stockholders.
8. Transferability of interest, creating a broad market for corporate shares.

Types of Corporations.—Although the detailed analysis of the many types of corporations in existence and the various necessary steps in the organization of such a business are considered to be beyond the scope of this book, the following broad classifications may be segregated:

1. A *private corporation* formed for business purposes usually of a merchandising or manufacturing nature.
2. A *quasi-public corporation* such as a gas or electric light and power organization which is provided with capital from private individual sources and yet enjoys some public rights in the form of franchises for the location of pipe lines or transmission or distribution wires in the public highways. Such a corporation is a public servant, but because of such service it is granted powers of eminent domain by the state or the municipality.
3. Purely *public corporations* such as municipal power and water companies which also enjoy the rights of eminent domain but which are provided with tax-supported rather than private capital.
4. *Corporations not for profit* such as charitable, educational, and fraternal organizations.

Powers of the Corporation.—Generally speaking, a corporation has all the powers that an individual has except those personal rights of voting, etc.

The most important powers of the corporation are:

1. The right to own, sell, purchase, mortgage, and otherwise pledge personal property and real estate.
2. The right to exercise public franchise, and, in the case of quasi and public corporations, to enjoy the right of eminent domain.
3. The right to contract.
4. The right to sue and be sued as an individual for its acts of omission and commission.
5. The right to appoint agents who are fully empowered to represent, to bind, and to bring about profit for it within the scope of the agency.
6. The right to hold stock in other corporations, but usually without the right to buy its own stock.

As an illustration of one of the largest typical American public utility corporations, and simultaneously depicting many of the advantages of the corporate form of organization, the following quotation is most significant:

One of America's greatest industrialists was asked what stocks he would buy if he had only \$500,000 to invest in common stocks. "I would put," said he, "\$200,000 in American Telephone & Telegraph. . . ." It is such statements, repeated daily, that characterize A. T. & T. as the premier stock of the entire U. S., for either the small or large investor.

The almost universal favor in which the Telephone stock is held presents an extraordinary paradox: Wall Street likes the stock for a particular reason which the company says is absolutely invalid. Wall Street says that earnings of A. T. & T. will ultimately necessitate a larger return to stockholders. The company says this simply is not so.

The company is committed to a policy of distributing excess profits not to stockholders in cash but to its public in service—a policy expressed time and again by President Gifford.

Here, then, is a double contradiction: a privately owned corporation announces that its primary allegiance belongs to the people who buy its service instead of to the people who buy its stock. And after making—and reiterating—this announcement, it easily retains its position as the corporation with the most widely distributed securities in the world, its stockholders numbering more than 500,000.

It is advisable to explain what the A. T. & T. Co. is. The telephone business is the biggest business in the world. Almost the only comparison to it is that other and even more complete utility monopoly known as the U. S. Post Office.

The company began life as a patent monopoly, like the Aluminum Co., and—also like the Aluminum Co.—might very well have come under the domination of one of its early backers. But it has long outgrown its founders. Nor has any banking Jack climbed any financing beanstalk to hew the giant down. No one has ever underwritten any of its stock issues. In 1876 it tried to sell itself to Western Union, but the telegraph company (in what now appears as one of the major stupidities of modern economic history) did not think telephones worth \$100,000 and so failed to make an investment which has now grown to be 42,000 times that. Today, with some 500,000 stockholders averaging about 30 shares each and not one holding more than seven-tenths of 1 per cent of the stock (largest holders are Sun Life Assurance and George F. Baker), the management of the company is responsible only to its board of directors, which is dominated by no bank, no interest, no controlling clique. It is important to remember this point in view of Mr. Gifford's resultant ability to practice what he preaches.³

On the other hand there are very small corporations and the so-called "closed corporations," whose shares of stock are held by a minimum legal number of individuals who may dictate the policies of the corporation so long as they succeed in holding a voting majority of the stock. Such organizations, although having the legal form of the corporation, are more nearly partnerships in their administrative methods.

A good example of such an organization was recently disclosed in a hearing before the Examiner of the Federal Radio Commission in Washington, D. C., in which the petitioner for a radio-broadcasting license, having considered that his application might have more prestige before the commission if made by a corporation, finally admitted upon rigorous cross examination that of the 612 outstanding shares of the corporation he held 604 shares himself and that two others holding four shares each as required by law had not yet paid for their allotment.

Legal counsel should be sought and a careful study of the intricate problems of corporations and partnerships made before organization is undertaken in any particular case. Some of the essentials of corporate organization and management which should be known to every layman will, however, be outlined in the succeeding chapters. It may be well to note, however, that this discussion will relate only to corporations organized for profit, and not to such organizations as clubs, churches, the Y.M.C.A.. etc., which, although organized under a state charter

in a similar manner, depend largely upon dues and donations for their support and are distinguished as nonprofit corporations.

Specific References

1. BUTLER, NICHOLAS MURRAY: "Why Should We Change Our Form of Government," p. 82, New York.
2. LINDLEY: "Partnership," vol. I, p. 110 (Ewelk, 2d American ed.).
3. "World's Largest Corporation: Its Stock," *The Reader's Digest*, condensed from *Fortune, Magazine* September, 1930; copyright, Time, Inc.

General References

- ALLEN, C. FRANK: "Business Law for Engineers," McGraw-Hill Book Company, Inc., New York.
- CONYNGTON, THOMAS, R. J. BENNET, and PAUL W. PINKERTON: "Corporation Finance," Ronald Press Company, New York.
- COOK, W. W.: "Principles of Corporation Law," Lawyers Club, University of Michigan, Ann Arbor, Mich.
- DONALD, W. J.: "Handbook of Business Administration," McGraw-Hill Book Company, Inc., New York.
- MONTGOMERY, R. H.: "Financial Handbook," Ronald Press Company, New York.
- RIPLEY, WILLIAM Z.: "Trusts, Pools and Corporations," Ginn and Company, New York.

Review Questions

1. List the principal advantages of a proprietorship over a partnership.
2. Are all the partners in a partnership necessarily equal in (a) the money they contribute; (b) the work they do; (c) the profits they share; and (d) the liabilities they assume?
3. List the principal advantages of a partnership as compared to a corporation.
4. Distinguish between the legal and commercial understanding of the partnership.
5. Discuss the importance of the corporation in modern society.
6. Define a corporation.
7. Name the information usually contained in the articles of incorporation.
8. List the principal advantages of the corporation over the partnership.
9. What determines the state in which a proposed corporation is to be incorporated?
10. Name and define the types of corporations.
11. What powers does a corporation have?
12. What is a "closed" corporation?
13. Is there such a thing as a one-man corporation (a) legally (b) in effect?
14. Assume that you have invented a device and hold all the patent rights, and that you wish to manufacture and market this device.

- a. Under what conditions would you choose a proprietorship form of organization and what legal steps would be necessary?
 - b. Repeat (a) for the partnership form of organization.
 - c. Repeat (a) for the corporation form of organization.
15. Can a corporation undertake business not included in its charter providing there is no competition?
16. Complete each sentence below by writing at the end the most appropriate of the following three words: proprietorship, partnership, or corporation.
- a. Centralized control is best obtained in a_____.
 - b. Capital is usually obtained by the sale of stock in a_____.
 - c. The death of one of the owners will dissolve a_____.
 - d. To have perpetual life the organization must be a_____.
 - e. Greatest secrecy is obtained in a_____.
17. Place a circle around the letter *T* or *F* according to whether you consider each of the following statements to be true or false, respectively:
- T F The partnership involves more risk for those participating therein than a corporation.
 - T F A corporation may have a longer life than a partnership.
 - T F A corporation has the same legal rights in court as an individual.
 - T F A corporation chartered in one state cannot do business in another.
 - T F The acts of one of the partners in a partnership bind the others.
 - T F Where the individual is the important factor, a partnership is often used.
 - T F Where absolute control by one individual is desired the corporation form of business organization is best.
 - T F A corporation may exist forever.
 - T F A corporation permits of transferability of interest.
 - T F A corporation doing business exclusively in Indiana must incorporate in Indiana.
 - T F A public utility may be operated as a partnership.

CHAPTER III

STOCKS, NOTES, AND BONDS

One of the principal advantages of the corporation over the partnership has been explained as the possibility, in the case of the corporation, of a flexible subdivision of the money invested. In order to provide for this, however, the funds invested are divided into small units designated as "shares of stock." The ownership of a corporation is evidenced by the number of shares of stock into which its capital is divided.

Definition of Stock.—Corporate stock is simply the right to share, under certain limitations of the management, the assets and earnings of the corporation. It has also been well defined as: "The vested interest which the owners of a corporation have in the company. A share is merely one of the equal parts of the capital stock." For example, if a corporation has been authorized to begin business with money and property to the value of \$100,000, which is known as capital, the funds may be supplied by stockholders purchasing 1,000 equal shares of the capital stock of the company at \$100 each. These might be purchased and held by 1,000 different people who had paid in \$100 each, or the money may have been provided by a few, each of whom may have made much larger investments. The latter form of organization, in which all the shares and, therefore, the control of a corporation are held by a comparatively few stockholders, possesses many of the characteristics of a partnership and is designated as a closed corporation.

Stock Certificate.—Stock is personal property, and can be bought, sold, or pledged at the wish of the owner. Shares of stock are therefore represented by stock certificates, which are merely evidence but not proof of ownership of a certain number of shares of stock in a given corporation as specified thereon. In fact, the loss or destruction of such a certificate might embarrass the owner only temporarily, as would be the case in the loss of a deed to real estate. The stockholder may still vote and

collect his dividends but before he could sell his stock a duplicate of the stock certificate would have to be secured from the company.

The certificate of stock is, therefore, purely a matter of form and convenience since the ownership of the stock frequently exists before the certificate is issued, the records appearing upon the books of record of the corporation. Certificates of stock are not strictly negotiable as they are treated in common law. Therefore a bona fide purchaser of a stock certificate, which had been previously endorsed in blank and then lost or stolen, would not be protected at law against the true owner unless the owner was adjudged guilty of negligence.* In ordinary business practice, however, stock certificates have been treated as negotiable instruments and in some states they have been made legally negotiable by legislation. The real ownership of stock is determined, therefore, only by the transfer of stock upon the stock book of the corporation.

The stock certificate usually takes the form of a statement by the corporation, signed by its duly qualified officers, such as the president and secretary under the corporate seal, that the owner of the stock, whose name appears on the certificate, is entitled to a certain interest in the corporation as indicated by the certificate, in the amount and number of shares that appear on the face of the certificate of stock. Possession of the certificate of stock by the proper owner indicates that the stock has been fully paid for, unless qualified otherwise in the certificate; so far as third parties are concerned, the corporation has no claim against them if the stock is not fully paid for by the person to whom it was originally issued.

At the will of the owner of the stock who holds the stock certificate, his interest in the corporation, represented by such a certificate, may be sold or transferred to other parties. Such transactions cannot be prohibited by any regulations of the corporation. Although such a procedure is legally completed between owner and purchaser, yet the corporation may fail to recognize the new owner, for the payment of his dividends, until the stock is formally transferred upon the books of the company. Provisions are therefore made for the transfer by endorsement

* Cook on Corporations, Par. 358, *Knox v. Eden Musee Co.*, 148 N.Y. 441 (1896).

upon the stock certificate to the purchaser. This document may then be surrendered to the company by the purchaser and a certificate issued by the company to the new owner. It is very important that the stock records of the corporation should accurately indicate the owners of the stock, not only in order that dividends may be paid to the proper owner, but in order that the personnel of the legitimate voters may be determined at meetings of stockholders.

Such receipts for a stockholder's investment in the stock of a corporation, as stock certificates have sometimes been defined, should include, if correctly and completely worded, the following information of interest to its owner: date of issuance; serial number of certificate; the state in which the company is incorporated; capitalization; type of stock represented; number of shares of stock authorized; number of shares of stock represented by the certificate; par value of the stock if it has a par value; rate of dividend to be paid, if predetermined; statement of ownership of stock by particular individual; dates and names of parties to whom it may have been transferred; signature by officers of company authorized in bylaws to sell or transfer stock; seal; witnesses; etc.

Stock certificates are usually engrossed in the form of elaborate colored plates and are similar to large-size bank notes in appearance, as indicated in Fig. 2.

Types of Stocks.—In order to meet the needs of a wide variety of corporations and the convenience of numerous stockholders who may have various relations and financial obligations toward the corporation, many types of stock have been developed. The most important classes of such stock, accompanied by a brief identification of each, may be listed as follows:

Common stock specifies a definite portion of ownership of the capital and assets of the corporation, all such shares being alike in value. The dividend upon such stock may vary from year to year at the discretion of the directors and frequently no dividend is paid for several years. If there is no preference given to stock by the charter or bylaws of the corporation, such stock is designated as common stock.

Preferred stock, as the term implies, represents a certain class of stock enjoying special privileges over common stock, which are set forth in the charter or bylaws, either with respect to divi-

dends or assets or both. Such stock usually carries a guarantee that a definite dividend rate will be paid thereon at each dividend period before any dividends can be declared by the directors upon common stock. Preferred stock may have cumulative or non-cumulative stipulations regarding its dividend payments. In the former case, if for any reason the dividend is not paid during one dividend period, the accumulated dividend must be paid at some later period before dividends may be declared upon common stock.



FIG. 2.—Stock certificate.

Preferred stocks of different issues may provide a variety of dividends and features regarding redemption, liquidation rights, and accumulation of dividends and may therefore be designated as first, second, or third preferred stocks in sequence of issue.

Class A, B, Etc., Stock.—Either preferred or common stocks may be subdivided into classes. In the case of preferred stock such subdivision usually indicates the sequence of certain preferences either as to dividends or as to claims upon the assets of the corporation, Class A having precedence over Class B, etc. With such a classification of common stock, however, the right to vote may be limited to Class A stockholders and, since this classification may include a relatively small number of shares, the voting strength may in such cases be limited to a relatively

small portion of the total capital investment and also to a relatively few stockholders. Thus, in analyzing the possibility of control of the policies of the corporation as well as the value and safety of the investment in stock, the rights of the holders of all the outstanding classes of stocks should be carefully scrutinized.

+ *Prior lien stock*, in the certificates of which a modifying clause is inserted, may provide that this stock shall have prior claim to any future bond issues upon the property. In such classes of stock this agreement takes precedence over subsequent bond issues. In all other cases, as will be noted under the discussion of bonds, the latter have prior claim over all types of stock.

Guaranteed stock is that whose income is guaranteed by some individual or corporation. A subsidiary corporation may thus have its stock dividends, which might otherwise be of little marketable value, guaranteed by a trustee or holding company, thereby strengthening the security of their investment.

Convertible stock, a form of preferred stock, may have provisions for its conversion, usually at a definite premium and before a prescribed date, into common stock or bonds.

, *Participating preferred stock* provides for further participation in dividends, proportionately with common stock, after preferred dividends and equal common-stock dividends have been paid. Although such participation is not an ordinary feature of preferred stock, it is implied in the payment of dividends unless expressly stated that some contrary procedure obtains.

, *Full-paid stock* is stock for which its full face value in money, property, or services, where payment is allowed by services, has been paid in by the stockholder. Such stock is free from any liability. In case of insolvency the investor loses his original investment in the stock, but in most states the creditors of the corporation cannot hold him for more than the originally invested values. The stock certificate for such stock is usually stamped "Full paid and nonassessable."

o *Assessable stock*, usually in contrast to full-paid stock, is stock that may have been partially paid for or received as a gift. Such stock, which may have in its certificate a modifying clause providing for assessment of its owner under certain conditions, carries a liability to nonassenting stockholders and to creditors of the corporation for the amounts unpaid.

/ *Treasury stock* is stock that has been lawfully issued and subsequently bought back by or donated to the corporation.

Since such stock is subject to disposal by the directors and may be resold by them at any price that may be obtained, no liability attaches to the purchaser to make up the deficit between the purchase price and the par value of similar shares of stock. It is correctly considered an asset of the corporation.

Unissued stock should be carefully distinguished from *treasury stock*. The unissued stock simply represents a right to issue which has been granted by the state and which may be exercised at some future time up to the prescribed amount. Such unissued stock cannot be considered as an asset of the corporation for it may be looked upon simply as an authorization to admit more members or shareholders to the corporation by *paying the prescribed fee*.

Bonus stock is stock that has been given away with bonds or preferred stock as an inducement to investors.

Watered stock, although not strictly a type into which certain shares of stock or stock certificates can be classified, is a term applied to stocks in general which are issued for amounts in excess of true appraised values of property ownership or capital which they are supposed to represent. Stock is often "watered" at the time of organization of the corporation by issuing stock to promoters or others for labor or property appraised at inflated values. For example, if fifty shares of stock of par value of \$100 each are issued for labor or property, appraised at the face value of \$5,000, but actually worth to the corporation but \$3,000, such stock is said to be watered to the extent of \$2,000 or 40 per cent.

The issuance of watered stock is explicitly prohibited by statute in some states although in many instances it is found rather difficult to designate a particular issue which is infringing the statute because of the implied water that it is said to contain.

One form of watered stock which is not infrequently found is that issued as a stock dividend where there are no increased capital values supporting the stock but simply an excessive earning capacity which shows itself in the form of fictitious stock dividends. Such issues should, however, be carefully distinguished from the legitimate stock dividends which take the place of cash dividends of equal justifiable amounts where the reserved cash or equivalent property is added to the working capital of the company. In the latter case the issued stock cannot be criticized as being watered, but actually represents

increased values which may be realized in the event of liquidation of the company.

Stock Values.—As the result of common knowledge of the fluctuations of values of stocks from moment to moment upon the Stock Exchange for no apparent reason at all, one is likely to assume that such market quotations, fictitious and variable in character, represent the only values that such stocks may acquire. Such values should be carefully distinguished from one another as follows:

The market value of a stock is the price for which it can be sold in the open market by a willing seller to a willing buyer. Such values are dependent upon the credit of the corporation, the condition of the investment market, its original book value, and its earning power.

Book value of stock is established upon the books of the corporation issuing the stock. If the corporation has only a common-stock issue, the book value is determined by dividing the net worth of the corporation by the number of shares of common stock outstanding. The net worth of the business is defined as the excess of total assets over liabilities. Thus assets (\$160,000) less liabilities (\$40,000) equals net worth (\$120,000). Net worth \div (1000 shares) = \$120 per share as book value.

If the company has issued both preferred and common stock, the book value of the former should represent the claim of each share upon the assets in the event of liquidation plus any accumulated dividends. The remainder of the net worth divided by the number of shares of common stock then determines the book value of the latter. With many issues of various classes of preferred stock, such a calculation, and therefore the true book value of each class of stock, becomes rather involved.

Par value of a stock is that stated definitely upon the certificate of stock, which in most states may be any amount from \$1 to \$100. The majority of stocks have a par value of \$100, although some industrial and mining stocks have been issued at very much lower par values in order to make them more attractive to small investors.

No-par-value stock is receiving more attention each year as its advantages become better known. Introduced first in New York State by legislative enactment in 1912, after a careful study and much discussion by legal experts, most of the states have since

legalized this form of stock, the constitutionality of which has already been well adjudicated by the courts.² Such a stock certificate simply states that it represents a fractional interest in the capital stock of the company with a pro rata claim upon the assets of the corporation after payment of its creditors.

The basic arguments in favor of the establishment of no-par-value stock as well as its important advantages are best stated in the following quotation from "The Financial Policy of Corporations" by Dr. Dewing of Harvard:

Capital stock . . . involves two distinct ideas . . . a participation in the rights of ownership and a valuation of this participation. This latter is the par value. It is the less important. The stockholder may never collect, like the bondholder, the par value of his security from the corporation. Even though paid for in full and representing for a short time the full and actual value, the equality passes with the first business transaction, for the value of the corporation property changes with every success or failure of the corporation. . . . The essential character of the capital stock that remains permanent, whatsoever the fortunes of the actual capital, is that it stands for a definite proportion of the corporate property and earnings. This involves no par value. The purpose of the stock would therefore be fully accomplished if the shares were merely proportionate parts of a total, or in other words, shares without par value.

There could be, aside from doing away with the meaninglessness of par value, certain specific advantages. The most conspicuous is that of truthfulness. Without par value there is no pretense that the actual property of the corporation is equivalent to the par value of its shares after the liabilities are met, and there is no insinuation of overcapitalization or undercapitalization. In other words the capital stock would stand merely for proportionate shares in the earnings of the corporation, and, if the corporation be liquidated, the proportionate shares in the equity remaining after all other claims had been satisfied.¹

There seems to have developed few if any serious disadvantages to the use of no-par stock. Among those which have been mentioned is the fact that such shares have sold less rapidly to certain classes of investors who conservatively held to early traditions and procedure—those who were slow to purchase anything new or certificates that did not bear a dollar sign, whether such a sign was a true or false indication of real values inherent in the stock. Some minor but rather temporary difficulties in accounting and in the assessment and standardization

of methods of taxation constitute most of the criticisms of the new practice.

Because of the many unique features of no-par stock and the resulting fact that such stock certificates are frequently misunderstood, the following summary of the most thoroughly tested enactments, i.e., those of New York State, with incorporated amendments resulting from experience and usage under the original legislative act of 1912, is quoted:²

Upon formation or reorganization, any business corporation may provide for the issuance of unvalued shares (other than preferred shares) without any nominal or par value, by stating:

1. The number of shares that may be issued, and, if any stock is preferred, the preferences, with the amount, character, and par value of such preferred stock which shall be \$5 or some multiple of \$5 up to — not exceeding \$100.
2. The amount of capital which it will use in conducting its business. This must be not less than \$500 and not less than the par value of the preferred stock, plus \$5 or some multiple of \$5 for every share of other (unvalued) stock.

Each share of unvalued stock must be equal and each certificate shall have written or printed thereon the number of unvalued shares represented by it, and the entire number of such shares authorized.

The corporation may sell such unvalued shares (1) for such consideration as may be prescribed in the charter; or (2) at their fair market value, the judgment of the board of directors as to such fair market value being conclusive in the absence of fraud; or (3) the price may be fixed by consent of two-thirds of each class of shares voting at a duly assembled stockholders' meeting.

All unvalued stock so issued shall be deemed full paid and non-assessable.

Such corporation shall not begin business or incur debt until the amount of capital stated in the charter shall have been paid in money or property at actual value. Violation of this prohibition makes directors assenting personally liable.

The organization tax on such corporations shall be 5 cts. on each share of unvalued stock. The stamp transfer tax shall be 2 cts. on each share.

This law does not require that all corporations which incorporate within New York State make use of this no-par stock, but leaves the selection to the corporation. Two of the strongly protective features of this law are the clauses that provide for

the statement of the amount of capital necessary to begin business and that of holding the directors personally liable if they authorize business or incur debts before the amount stated has actually been paid in.

Many of the other states which have subsequently enacted laws providing for no-par stock have not supported the new laws with these protective features. For this reason and because of the further possibility of incorporating in another state which has such important enactments, even though business is transacted as a foreign corporation in the home state, a careful survey of the no-par stock and its possibilities in various states should be made by prospective incorporators before undertaking such an act.

CORPORATE BONDS

Corporate business is carried on largely with borrowed capital. Contrary to the status of an individual who is always in debt, a corporation that is doing business partially upon borrowed capital is considered more favorably than one whose credit is such that it cannot rapidly borrow money to expand its activities. If money can be borrowed for long terms at $4\frac{1}{2}$ or 5 per cent and a net profit made as the result of the use of such funds in excess of that rate of interest, it is usually considered good business to borrow. This borrowed capital is obtained usually by the sale of long-time bonds or by the execution of short-time promissory notes. These two forms of paper are almost identical.✓ The major difference is the length of time for which they are executed. The bond may be issued for ten, twenty, or thirty years or even longer. The promissory note does not usually exceed two years.

Borrowed Money.—Since the party from whom such money is borrowed does not purchase shares of stock and thereby become a part of the corporation, some security must be given to protect the lender and to assure the repayment of the money borrowed at the end of some prescribed period of years.// This process is accomplished by issuing bonds in the name of the corporation borrowing the money. These bonds are usually worded like a promissory note. One form, not unlike the average corporation bond, is the U. S. Liberty Bond with which the public is now very familiar. In fact, the publicity given to Liberty Bonds by the United States during the war has materially

stimulated the investment by the public at large in corporate bonds and stocks as well. A typical form of bond may be found in Fig. 3.

Definition of a Bond.—A bond is defined as "a formal obligation executed by a corporation and usually secured by trust deed

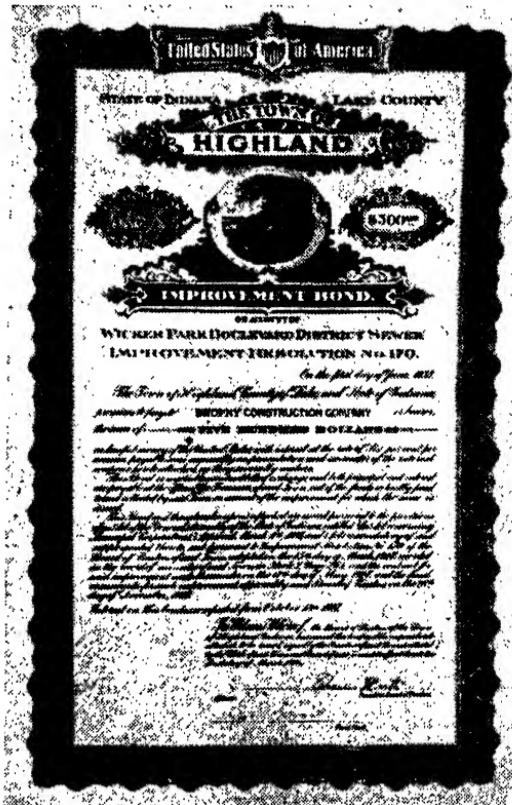


FIG. 3.—Improvement bond.

upon the plant or assets of the company." Bonds are usually issued in units of from \$100 to \$1,000 in order that a large loan may be placed among many investors and so that the latter may all be adequately secured.

Six important items which should normally be expected to be set forth in every bond are:

1. Acknowledgement of indebtedness of the company for value received.

2. Covenant to pay principal and interest, with time and place for payment of each expressed.
3. Description of the bond issue, of which this bond is a part.
4. Statement of security (mortgage, etc.).
5. Statement of the rights of the holder in case of default.
6. Certificate of authentication, endorsed by the trustee.³

Classification of Bonds.—Bonds have been broadly classified into three main groups designated as (1) mortgage bonds, (2) collateral trust bonds, and (3) debenture bonds. The following chart classifies some of the numerous classes under these three captions.

TABLE III.—CLASSIFICATION OF BONDS ACCORDING TO SECURITY

- A. Mortgage bonds.
 1. First mortgage.
 2. Junior mortgages.
 - a. Second, third, etc.
 3. Terminal and Divisional mortgages.
 4. Refunding, consolidating, and unifying mortgages.
 5. General mortgages.
 - a. Open mortgage.
 6. Sinking-fund mortgage.
- B. Collateral trust bonds.
 1. Collateral trust.
 - a. Lumber, products, stock, other paper of subsidiary companies.
 2. Equipment bonds.
- C. Debenture bonds.
 1. Participating.
 2. Profit sharing.
 3. Convertible.
 4. Income.

There are, however, many subclassifications of bonds which are shown in the following chart:

CLASSIFICATION OF BONDS⁴

- A. Security of bonds.
 1. First mortgage.
 2. Second mortgage, third, etc.
 3. Terminal, divisional, land grant, or other special mortgages.
 4. General mortgage.
 5. Sinking fund.
 6. Collateral trust.
 7. Equipment trust.
 8. Debenture.
 9. Income.

10. Participating.
 11. Profit sharing.
 12. Joint.
 13. Receivers' certificates.
- B.* Purposes of bonds.
1. Unifying.
 2. Refunding.
 3. Construction.
 4. Purchase money.
 5. Improvements.
 6. Extensions.
 7. Adjustment.
 8. Consolidation.
- C.* Manner of payment.
1. Coupon.
 2. Registered.
 3. Registered as to principal, but dividends in coupon form.
- D.* Condition of redemption.
1. Gold.
 2. Redeemable.
 3. Serial.
 4. Convertible.
- E.* The character of the issuer.
1. Railroad bonds.
 2. Public utility bonds (not including railroads).
 3. Municipal bonds.
 4. Industrial bonds.
 5. U. S. government bonds.
 6. State government bonds.
 7. Miscellaneous bonds, including timber, land grants, irrigation, levee, drainage, real estate, etc.
- F.* The purpose of issue.
1. Purchasing or consolidating properties or companies.
 2. Construction and extensions.
 3. Improvements.
 4. Unifying, refunding, or consolidating other issues.
- G.* The privilege and conditions of payment.
1. Of principal.
 - Convertible bonds.
 - Redeemable bonds.
 - Callable bonds.
 - Serial bonds.
 - Registered bonds.
 - Negotiable bonds.
 - Sinking-fund bonds.
 2. Of interest.
 - Coupon bonds.
 - Registered bonds.

Income bonds.
Participating bonds.
Profit-sharing bonds.

H. Their security.

1. Simple obligations.
 - Plain bonds.
 - Debenture bonds.
 - Long-term notes.
 - Certificates of indebtedness.
2. Reinforced obligations.
 - Bonds secured by guaranty.
 - Assumed bonds.
 - Guaranteed bonds.
 - Indorsed bonds.
3. Bonds secured by lien, on:
 - a. Personal property.
 - Sinking fund.
 - Equipment.
 - Paper collateral (known as collateral trust bonds).
 - Stocks.
 - Bonds.
 - Mortgages.
 - Leases.
 - Certificates of interest.
 - b. Realty, according to:
 - Character of property mortgaged.
 - Priority of the lien.

Mortgage Bonds.—First-, second-, or third-mortgage bonds are secured by the respective mortgages upon the tangible property of the corporation issuing the bond and, as in the case of the mortgage, the bondholders have, respectively, the first, second, or third claim upon the returns from the sale of the property in case of insolvency." In general, the bonds carrying the best mortgage security are recognized as the most conservative investment and, as a result, bear the lowest interest rate, other conditions being considered equal.

Junior Lien Bonds.—A class of bonds of secondary security to first-mortgage bonds and corresponding to second- and third-mortgage securities in general are called junior lien bonds.

Although it would be beyond the scope of this discussion to enter into the details of mortgages in their many varied forms, it is necessary to point out one or two important considerations in the wording of a mortgage which may materially affect either

the future financing of the corporation or the ready sale of bonds at a reasonable price and interest rate.

A mortgage is a deed in form, but differs therefrom for the reason that, if paid in full, the property belongs to the mortgagor. In fact, the title never changes hands unless the mortgagor fails to pay the interest upon the principal of the mortgage. If such failure takes place, the mortgagee may foreclose the mortgage, claim the property, and sell the same, as prescribed by law, to secure the money loaned thereon.

In many instances the mortgage is made out, not to the person or persons loaning the money, for in the case of sale of bonds there are many such, but rather to a trustee or trust company. The trustee takes the responsibility of holding the securities of the bond issue and requiring that such securities be maintained at the proper value to protect the bondholders. In case of failure to pay interest upon the bonds, the trustee acts as agent for the bondholders and is often appointed by the court as the receiver in case of insolvency.

Subsequent Bond Issues.—It is to be expected that a successful, growing business will need additional funds to be borrowed in the future. For the protection of present bondholders, the mortgage may be so worded that new property, not subject to this particular mortgage, cannot be purchased and no further mortgage can be levied upon present property. Provisions are also included which assure the maintenance of present mortgaged property in good condition and repair. The former clause naturally limits future bonding, but improves the conditions of bond sale and interest at the outset.

There are two ways of overcoming this disadvantage:

1. Establishment of a bond reserve
2. Use of an open mortgage

Bond Reserves.—The bond-reserve plan provides for future funds by mortgaging and bonding for larger amounts at first than will be necessary, and reserving the sale of a portion of the available bonds until some future date when more capital is needed. This practice obviously implies a large amount of valuable tangible property to act as security for such a large issue of bonds.

Open Mortgage.—An open mortgage does not stipulate definitely the amount for which a given property or its future

extensions may be bonded, but may permit further bonding and mortgaging upon the same security. A mortgage thus worded opens the way for future financing but decreases the protection of the bondholders of the first issue. The open-mortgage clause may seriously affect the sale of the first issue of bonds or require that their discount or interest be too great. Such mortgages are not very common.

Collateral Bonds.—Bonds do not necessarily have real estate for security. Particularly in cases of consolidation of corporations, the stocks or bonds of a subordinate corporation may be filed with a trustee as security for the bonds of the holding company. The latter bonds issued upon paper security are known as collateral bonds or collateral trust bonds. They may obviously have first claim upon the assets of the holding company but are in the nature of a second mortgage upon the real estate of the subordinate company. Since, however, they are usually issued by a strong holding company enjoying good credit, they are considered, in general, a conservative investment.

Debentures.—In contrast to the bonds already described should be listed debenture bonds, which have no security at all. These are really long-term unsecured promissory notes. Their holders depend upon the continued success of the corporation and its ability to keep out of bankruptcy for the return of their premium. In case of insolvency they rank after all other bondholders in their claims upon the assets of the corporation. Although theoretically they have no more claim than other creditors, "they are usually given a place between mortgage or collateral bondholders and preferred stockholders." Such bonds are ordinarily issued during the reorganization of corporations to reduce the mortgage indebtedness of the corporation. It should be definitely understood therefore that further issues of mortgage bonds will not be made unless the debenture bonds are given equal protection. Otherwise the safety of debenture bonds might be seriously impaired.

Debenture bonds are more popular abroad than in this country. They are issued principally by railroads. Purchasers look upon the earning power of the railroad as a better measure of security than railroad tangible property. They argue that in case of insolvency the value of railroad property would depreciate so greatly that the security offered by a mortgage thereon would be

of little value. In the United States, however, greater security is desired and, with the exception of a few New England railroad debentures, they have not enjoyed very extensive issues.

Greater popularity and some speculative features have been added to the debenture bond issues in this country by making them also "convertible" bonds.

Convertible Bonds.—A convertible bond is one which, after a definite date, may be converted into stock of some particular type at some designated price above its par value, such as 105 or 106. In case the corporation is prosperous and pays good dividends, the possibility of this transfer at a premium counteracts the lack of security of the debenture bonds. This convertible feature is by no means confined to debenture bonds for it may be associated with bonds of all types, but it is referred to here as a special inducement of added attractiveness in the case of the limited security of debentures.

Participating Features.—Another feature which may be added to debenture or other bonds is that of participation in the profits over and above the regular prescribed interest. A participating bond is one which, after a predetermined maximum dividend has been paid on preferred and common stock, receives an additional dividend in common with the stock. The extent of such participation is usually limited either by bylaws, charter, or the wording of the bond itself.

It should be noted that, although both convertible and participating bonds tend to render the capitalization and dividend issues more unstable, the former produces another more radical irregularity in corporate management in that it transfers bondholders, who are creditors of the corporation, to the position of stockholders or owners. Such sudden conversions, particularly at a time of financial crisis, may materially disturb the normal financing and policies of the company.

It is not practicable to describe in detail the many varied types of bonds indicated in the classification given previously in this chapter. The careful investor must analyze all the features of any particular issue in detail, while the bond salesman, promoter, or corporation director must study the history and legal status of all types of bonds and stocks in order to master their relative advantages and values. It must suffice, therefore, to point out a few additional features of bonds which are rather commonly met with in various types.

System of Rating.—The system of rating securities was originated by John Moody and has been developed by Moody's Investors Service during the past twenty-six years. The method by which securities are rated is the outgrowth of many years of experience and of the best efforts of many minds. These ratings enjoy widespread use among all classes of investors.

Significance of Rating Symbols.—Under the system of security ratings, bonds are divided into a number of general classifications. First of all are the most conservative types of investment year in and year out. Their investment qualities are not likely to be changed by special influences such as earnings, in the case of a corporation, or current financial condition, in the case of a municipality. In most instances, such bonds will tend to fluctuate in price with the fluctuation of the prevailing long-term interest rates. Such classification embraces bonds only slightly lower in investment qualifications.

Next in turn comes the *A* rating classification and this symbol is used to designate securities which, though having distinct investment qualities, do not have those elements of strength which would necessarily prevent their intrinsic worth from being affected by some special development. From the *A* classification downward, the successive symbols indicate decreasing investment qualities and increasing speculative characteristics. Thus, while *Baa* bonds are reasonably close to *A* bonds in investment qualifications, the same may not be said of *Ba* and *B* issues, while those rated *Caa*, *Ca*, etc., represent almost purely speculative securities.

Not all securities have been assigned ratings. Where no rating has been assigned, the reason is generally the absence of sufficient financial or other information to permit a sound judgment to be formed. Absence of a rating indicates neither good nor bad investment quality in any given case.

Rating Changes.—Changes are necessarily made in the ratings assigned to individual issues. Such changes should serve as a notice to investors of an alteration in the investment status of the security in question. Among issues carrying the highest ratings, changes are obviously few and far between but, by their very nature, those carrying lower ratings are more often subject to revision. Indeed the very definition of a speculative security connotes the likelihood of change in its qualities.

Limitations to Uses.—Ratings do not attempt to forecast market-price movements. The only forecast involved is, for instance, that *Aaa* bonds will not change their investment status much, if any, as far as can be foreseen. On the other hand, again for example, *Ba* bonds are fully apt to change their investment status, and the change may be either for better or for worse.

Ratings do not, in themselves, amount to recommendations. It does not signify that because a security has a high investment rating it is necessarily to be recommended as likely to improve in market value. Similarly, a security of lower rating may be either attractive or unattractive for purchase or holding, depending largely on the requirements of the investor, and especially on market price and other factors which the rating system does not in any way attempt to take into account.

Ratings are not intended to indicate stability of market price. While it is true that *Aaa* bonds, as a class, fluctuate in price over a narrower range and are generally more stable than lower rated securities, it is not at all true that *Aaa* bonds are absolutely stable. All long-term bonds fluctuate in price due to general conditions.

The investor cannot assume that *all Aaa* rated bonds are of absolutely equal quality and desirability. In such broad classifications it is fully evident that this cannot be the case. Some *Aaa* bonds are of higher quality than other *Aaa* bonds. Some *Aa* bonds are of higher quality than other *Aa* bonds, etc. Moreover, other characteristics besides quality may well influence the investor's choice and this is especially true when it comes to lower rated securities. For example, at a given time a *Baa* bond may have approximately equal investment strength with another *Baa* bond, but in the first case the trend in the industry represented may be downward, whereas in the second it may be upward. In this connection it is again important to repeat that the more speculative ratings denote a tendency for change, and, if the ratings are to be intelligently used, the investor must take note of other surrounding circumstances, including the direction of change at the moment.

Stock Ratings.—The practice of rating stocks has been discontinued. This change of policy applies to all classes of stocks. The discontinuance of stock ratings is not, however, to be understood as having any bearing on the investment qualities of stocks as a class or of any particular issue.

Refunding Processes.—Attention should be directed to the fact that it is not expected that the corporation will cease operating upon borrowed money; if a profit may be made now as a result of borrowing money at 4 or 5 per cent, it is likely that good business policy will dictate the continuation of such a loan at the expiration of the term of the bond. Many very important and intricate problems arise, therefore, in connection with this procedure; a wise business judgment may prove effective in greatly improving the profits and credit of the business.

Some provision must be made for the continuation of such a loan at the lowest interest rate practicable. Some bonds must

be paid for in cash at the expiration of their term. The entire issue must be refinanced by means of some plan of mutual advantage to bondholder and corporation. Two methods are in general use in connection with the refunding of bonds.

1. A sinking fund may be set aside, from year to year, usually as a deposit made to a trustee, which with interest will produce a sufficient amount at the end of the term of the bond to pay the debt.* Such a plan is subject to the disadvantage that the payments to the sinking fund gradually detract from the use of the loan, which might be earning greater returns if invested in the business.

2. The business may be so managed and expanded that its credit will be improved to such an extent that a new bond issue, bearing the same or lower interest, may be floated and the new bonds either exchanged for the old or sold at such a figure that the old issue may be redeemed in cash.

The latter policy is, of course, preferable, when it can be accomplished. Such a possibility is not always apparent at the outset, however, and unless some sinking-fund provision is made the chances of floating the original bonds at a favorable interest rate may be reduced.

If the value of the property used as security for the bond issue is likely to depreciate, or its amount to decrease, as in the case of a mine, oil well, or real estate sales corporation, care must be exercised to redeem at least a portion of the bonds in cash. A sinking fund for such an issue becomes almost a necessity.

Provision is generally made in the wording of the bond for its redemption in rather definite terms. This fact leads to the classification of bonds based upon:

The Privileges and Conditions of Payment.—"Redeemable bonds" are those bearing some definite statement regarding their redemption previous to maturity. "Callable bonds" are those subject to call for cash at the will of the directors. Such provisions are often of value to the corporation in refinancing at the most opportune times, but they tend to make the bonds less popular because of the uncertainty of the market at the time the call is made. / "Serial bonds," as their name implies, bear serial numbers, which are usually redeemed in blocks, either at pre-determined dates and prices or subject to call upon advertise-

* See Chaps. XIV and XV.

ment. In some instances lots are drawn by a trustee to determine the serial numbers of the bonds to be redeemed at definite dates. Although this contributes still further to the uncertainty of the investor, the premium offered for bonds thus redeemed tends to reestablish their favor.

It will be remembered that during the sale of U. S. Liberty Bonds option was given the purchaser as to whether "registered" or "coupon" bonds should be provided. The former, whether government or corporation bonds, are definitely registered at headquarters in the name of the purchaser and the interest is regularly paid by check in a manner similar to the payment of dividends upon stock. Coupon bonds have interest coupons attached to the bond paper which may be torn off at definite interest-bearing dates and redeemed for cash. It will be evident at once that the added convenience of the registered bond is secured at the expense of negotiability. The meaning of convenience in reference to registered bonds is that the holder of the bond receives his interest regularly by check without effort on his part. Convenience in regard to transfer of bonds lies in favor of the coupon bond.

CORPORATE NOTES

The corporate problem of borrowing money with which to do business would not be complete if closed with a discussion of bonds alone. Bonds have been previously likened to promissory notes. Legally they are the same. Practically the bond is issued for a longer term of years, is of larger denomination, and is more formally secured and worded.

The promissory note, usually secured by such collateral as is ordinarily required of individuals by banks, is largely used by corporations for short-term loans. Such a note may have a life of from one month to two years, bearing interest slightly greater than the bond if other market conditions are identical. These notes are used largely as "working capital" to meet current demands upon the resources of the corporation pending the receipt of a definite fund with which they may be paid at a future date. Public service corporations have frequently issued many such notes in rather large denominations in lieu of a bond issue pending a more favorable market for bonds.

Equipment Notes.—If large units of equipment are needed by a corporation, such as railway cars, machinery, etc., the loan may be negotiated by the use of a combined lease and a series of short-term notes. The necessary equipment is supplied to the corporation either upon lease issued by the manufacturer or by a third person known as a trustee. The title to the property resides in the manufacturer or trustee until entirely paid for through the agency of a series of short-term notes. This practice has become so popular and common that such notes have been characterized as equipment notes. Even a bond issue may be financed by using equipment leases as collateral security for the bonds. Such bonds bear the name of equipment trust bonds.

TRADE CREDIT

As we thus consider the means of borrowing funds in relatively small amounts for short periods of time, the general use of trade credit must not be neglected. If the corporation is permitted by its creditors to purchase upon long-term credit, such as sixty or ninety days, and its sales can be closed upon a thirty-day basis or for cash in advance, as is often the case with public utilities, it will be seen that the use of the creditors' money during this period is no negligible privilege. Wholesalers and producers of raw materials have made such a practice of trade credit to retain their clientele that it is now practically forced upon them by competition and custom. This credit is usually recorded simply as Accounts Receivable* upon the general ledger of the creditor and the transaction rests for its security principally upon the sound business judgment of the creditor in conservatively extending the privilege and upon the honesty and good will of the debtor. Some losses, of course, result from this practice but they are probably small in proportion to the increased business resulting from the extension of the privilege to the trade rather generally.

Trade credit may be, and is in some lines of business, further protected by what is known as a "trade acceptance."† This consists of a draft, drawn through a bank, upon the purchaser by the seller for the amount of a bill of goods to be paid the bank

* See Chap. XVI, Principles of Accounting.

† See HARDING and CANFIELD, "Legal and Ethical Phases of Engineering," Chap. XV, McGraw-Hill Book Company, Inc., New York.

at a certain date. If such a draft is accepted by the purchaser, it becomes a trade acceptance and may be discounted by the bank as in the case of a note, thus freeing the money for the use of the seller at once. A charge is, of course, made by the bank for its work of collection and for the use of the money by the creditor. In short, the bank becomes the creditor for an interest consideration. Since the establishment of the Federal Reserve banks an attempt has been made by the federal government to extend the activities of the banks in the use of trade acceptances, but the majority of such loans continue to be carried as a private transaction between buyer and seller. A corporation may depend upon such credit to a certain extent depending upon its credit rating, the financial status of the country, and the practice in its particular line of business for some borrowed funds, but this possibility should not be overestimated in advance. It will not take the place of long-term bond issues or the sale of stock for permanent capital but will always be in demand to meet seasonal requirements for "working capital."

Specific References

1. DEWING, ARTHUR STONE: "The Financial Policy of Corporations," Ronald Press Company, New York.
2. Stock Corporation Law (Consolidated Laws of New York State, Chap. 59, as amended by Chap. 694 of Laws of 1921).
3. SQUIRE, A.: "Essential Recitals in the Various Kinds of Bonds," *Annals of American Academy of Political and Social Science*, 1907.
4. LOUGH, WILLIAM H.: "Corporation Finance," Alexander Hamilton Institute, New York.

General References

- CONYNGTON, THOMAS, R. J. BENNETT, and PAUL W. PINKERTON: "Corporation Procedure," Ronald Press Company, New York.
- DEWING, ARTHUR STONE: "A Study of Corporation Securities," Ronald Press Company, New York.
- GLAESER, MARTIN G.: "Outlines of Public Utility Economics," The Macmillan Company, New York.
- IGNATIUS, MILTON B.: "The Financing of Public Service Corporations," Ronald Press Company, New York.
- LAGERQUIST, WALTER E.: "Public Utility Finance," McGraw-Hill Book Company, Inc., New York.
- MONTGOMERY, R. H.: "Financial Handbook," Ronald Press Company, New York.
- RIPLEY, WILLIAM Z.: "Trusts, Pools and Corporations," Ginn and Company, New York.

SALIERS, EARL A.: "Accountant's Handbook," Ronald Press Company, New York.

—: "The Handbook of Corporate Management and Procedure," McGraw-Hill Book Company, Inc., New York.

Review Questions

1. What is a share of stock?
2. Distinguish between a share of stock and a stock certificate.
3. Name and define the various types of stock available.
4. What is meant by (a) market value; (b) book value; (c) par value; and (d) no-par value?
5. What precautions must a purchaser of a stock certificate take to insure receipt of any possible dividends that might accrue thereon?
6. What are the advantages of no-par stock over stock with a par value? The disadvantages?
7. In New York State, who is liable if a corporation issuing no-par stock starts business operations before the value of all the capital stock has been received?
8. What is a bond?
9. How are bonds classified?
10. Distinguish between a first-mortgage bond and junior lien bond.
11. What is a trust deed and what connection does it have with bonds?
12. When a mortgage is placed on property, is the title to the property thus mortgaged transferred to the holder of the mortgage?
13. Can the holder of the mortgage ever attain the property? If so, when and how?
14. Explain how bonds, subsequently issued on open mortgages, may result in depreciating the worth of bonds previously issued on such mortgages.
15. Distinguish between collateral and debenture bonds.
16. What is meant by refunding?
17. Distinguish between a bond and a note.
18. In what way do equipment notes differ from promissory notes?
19. How is trade credit used in the conduct of a business?
20. Assume that you have invented a device and hold all the patent rights, and that you wish to manufacture and market this device through the formation of a corporation.
 - a. What stocks would you issue, to whom, and why?
 - b. What bonds, if any, would you issue?
 - c. What notes, if any, would be justifiable?
21. Discuss the possible causes of fluctuations in the market values of stocks.
22. Does watered stock always imply overcapitalization?
23. a. What is meant by funded debt?
 - b. Distinguish between first-mortgage bonds and debenture bonds.
 - c. Name the advantages of no-par stock.
 - d. What is preferred stock?
 - e. What is common stock?

24. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

- T F A first mortgage bond is secured by physical property.
T F A debenture bond will generally have a higher interest rate than a collateral bond.
T F Market and par value of stock are usually equal.
T F Cumulative preferred stocks, in general, return higher percentage dividends than noncumulative preferred stocks.
T F A conservative investor would purchase a debenture bond rather than a first-mortgage bond of the same company bearing the same interest rate.
T F Ordinary preferred stock must have any defaulted dividend made up before a future common-stock dividend may be paid.
T F Equipment notes provide for the retention of title to the equipment by vendor until notes are paid.
T F Open-mortgage bonds, in general, will command higher interest than closed-mortgage bonds of the same company.
T F Dividends on preferred stock usually represent a higher percentage of par value than interest on bonds of the same company.
T F Watered stock usually implies overcapitalization.
T F Stock bought on the installment plan is assessable previous to full payment.
T F No-par value stock is sold at its market value.
T F Collateral bonds are secured by physical properties.
T F Stock sold at par is assessable.
T F Bonds purchased at a discount yield a rate of return higher than the interest rate upon their face value.

25. Mark true or false, as above.

- T F Market value of stock is always less than its par value.
T F The nominal dividend rate of preferred stock is higher than the interest rate on first-mortgage bonds of the same company.
T F Book value and market value of stocks are always the same.
T F Preferred stock usually has greater security than common stock.
T F Nonvoting preferred stock should be given a vote if the dividends are passed.
T F A certain share of stock may have at least three different, yet legitimate, values.
T F Debenture bonds are protected by more security than collateral bonds.
T F No-par stock represents true equity of the corporation more correctly than stock with a definite par value.
T F Par value of stock is always in excess of market value.
T F Bonds issued up to within 90 per cent of the valuation of a property are usually readily sold at par.
T F The use of convertible bonds may involve a future change of policy of the company.
T F Debenture bonds are secured by physical property.

CHAPTER IV

THE STOCKHOLDER, BONDHOLDER, AND TRUSTEE

Owners of shares of stock in a corporation are known as stockholders. They really constitute the corporation. In one sense they are partial owners of an enterprise in which the number of owners is usually great and constantly changing and for which the responsibilities of such partial ownership are limited by the number of shares held by each stockholder.

The privileges and responsibilities of stockholders, generally speaking, may be outlined as follows:

1. Elect directors to manage the corporation.
2. Prepare and amend the bylaws of the corporation or delegate such power to directors.
3. Increase or decrease the capital stock, subject to the provisions of the charter and state authorities.
4. Amend the charter if approved by state officials.
5. Dissolve the corporation.
6. Sell the corporation.
7. Levy mortgages.
8. Participate in dividends.
9. Examine books and records of the corporation at all reasonable times.
10. Purchase more stock under special privilege.

From this list of possible activities, the first seven of which require only a vote at the annual stockholders' meeting, it will be seen that the functions of stockholders are exceedingly limited. The principle of corporate control and management is that the stockholders shall have such portion of the profits as the directors prescribe, but that they turn over the entire management of the corporate business to their agents and representatives, who are known as directors and whom the stockholders elect at various annual meetings.

Every stockholder, whether he owns preferred, common, or some special form of stock, unless expressly denied, has a right

to vote at such an annual stockholders' meeting or any special intermediate meeting which may be called in accordance with the bylaws. Usually he is entitled to cast one vote for each share of stock standing in his name upon the books of the corporation as of a certain date, usually prescribed in the bylaws. Such a voting privilege is secured for him in a majority of states by statute provision. In other states such a right, if available, must have been provided in the charter or bylaws of the corporation itself. Otherwise the common law will prevail, under which every stockholder is entitled to one vote only regardless of the number of shares of stock that he holds.*

Ordinarily provision is made in the charter or bylaws for the *voting power to be limited to the holders of common stock only.* In direct contrast to this will be found the law of California, as a result of which no voting preference can be given to any class of stock. In the former very common situation, existing in other states, where the voting power is limited by charter or bylaws to the common stockholder, any provisions for the creation of preferred stock and, indeed, the preferred stock certificate itself should clearly set forth the nonvoting limitation of such shares. Thus limited, the holders of preferred stock have no more voice in the management of the corporation than have its bondholders. Furthermore, since they do not hold the strategic position of a creditor, as do the bondholders, the preferred stockholders cannot foreclose a mortgage or throw the corporation into the hands of a receiver in case of failure to pay interest.

A compromise which appears more equitable for the holders of preferred stock is frequently included whereby the latter have no vote so long as the preferential dividends are paid regularly; but if such fail for two consecutive years, then the holders of preferred stock shall thereafter have the right to vote.

The preferred stockholder therefore fills an intermediate position between the bondholder and the common stockholder. The former frequently furnishes the money represented by actual property while good will and other intangible assets offer the only basis for the issue of common stock. When a partnership is incorporated, the excess investment of one partner or the interests of a silent partner are often provided by means of preferred nonvoting stock. Thus greater safety of investment is provided

* *Taylor v. Griswold*, 14 N.J. L. 222 (1834).

than is usually associated with common-stock holdings and yet the dangerous foreclosure privileges of the bond may be avoided. Where an invention is taken over by a corporation and payment is made to the inventor in the form of stock, preferred stock is most frequently granted on account of its greater safety and its assurance of dividends. Such stock is much favored in the formation of industrial trusts.

Whereas, in a few instances, a preferred stock has been issued which may be later converted into a bond, attempts to include the advantages of both bonds and stocks in one issue have proved unsuccessful.

Courts will not permit the same security to create the two inconsistent relationships of stockholder and secured creditor. Irrespective of what the security may be called, they will look behind the name, determine the essential character of the security, whether it is that of a bond or a stock, and limit the holder to such rights as lawfully belong to that class of security.*

Care should be exercised by incorporators and prospective investors making use of preferred stocks since the statutes of various states differ considerably with regard to their issuance and such statutes, of necessity, take precedence over the common law. In New Jersey, for example, the law provides that "at no time shall the total amount of preferred stocks issued and outstanding exceed two-thirds of the capital stock paid for in cash or property" and statutory authorization for the issue of preferred stock is not necessary.† The provisions creating preferred stock should be framed with care, for the law reports abound with suits arising from ill-defined preference stock rights.‡

Voting Privileges.—Whether one is a holder of preferred or common stock, and regardless of the real reason for purchase of stock by the investor, the important legal function of the stockholder is that of voting. The stockholders meet annually, or upon call when special need arises, and register their vote, either in person or by proxy, upon the questions at issue. The determining vote, whether majority, two-thirds, or three-fourths, is

* Cook on Corporations, Par. 271.

† *Kent. v. Quicksilver Mining Co.*, 78 N.Y. 159 (1879).

‡ Machen on Corporations, Par. 549.

determined in some instances by legislative enactment, but ordinarily by charter or bylaws.

Stockholders who cannot be present at meetings and yet who wish to register their vote may do so by providing a proxy. A proxy is simply the *power of attorney* expressed in form similar to the following authorizing a second party to register a vote for the stockholder whose signature is appended.

STOCKHOLDER'S PROXY

Know all Men by these Presents:

That I, _____, holder of _____ shares of the capital stock of the _____, a corporation of the State of _____, do hereby appoint _____ my true and lawful attorney (with full power of substitution and revocation), for me and in my name to vote as my proxy, at the _____ meeting of the stockholders of said company, to be held on the _____ day of _____, 19_____, and at any adjournment thereof; hereby ratifying and confirming all that said attorney (or substitute), may lawfully do in the premises.

Witness my hand and seal, this _____ day of _____, 19_____.

In presence of _____.

This privilege may, of course, be prohibited by statutory provisions or by charter, but is rather generally practiced in most states. Proxies are usually not irrevocable but are frequently issued for a definite period of time or for a single stockholders' meeting, beyond which they are void.

One important function which may be performed with the aid of proxies is that of control of corporate policies by the minority stockholders. In most corporations there are many stockholders who never vote. It is not unusual in large corporations to have less than three-quarters of the outstanding stockholders represented, proxies included, at a stockholders' meeting. If a concentrated minority is active in securing proxies from many otherwise passive stockholders previous to a meeting, the combination of personal minority plus favorable proxies may establish control.

Obviously, unless some special provision is made to prevent such action, the votes corresponding to a majority of shares of voting stock will determine the policy and elect the board of directors of the corporation. These determining shares may be held by one or many different individuals. In some instances,

particularly in early railroad corporations, thousands of stockholders, scattered widely about the country, held but a few shares of stock each but yet represented a very important group of voters. With a controlling vote in the hands of one or two large stockholders, the wishes of the many are overruled. In order to obviate this real difficulty, several methods of voting have been developed.

Voting Trust.—A voting trust may be established by the stockholders, made up of dependable and experienced men of sound business judgment. To such a trust the voting rights of the stockholders are assigned for a definite period of years. Such an arrangement is becoming less popular. It is really a long-term general proxy.

Cumulative Voting.—Another and more common arrangement is known as cumulative voting.* This is a method of voting for directors which permits such accumulation of votes that the holders of less than a majority of voting stock may, by proper combination, elect one or more members of the board. Under the ordinary method of voting, this would be impossible.

It is, of course, to the advantage of the minority stockholders to have some representation upon the board of directors in order (1) that they may be kept informed regarding the general affairs of the corporation, (2) that they may know of any official action taken by the board, and (3) that they may be able to present to the directors the ideas and policies of special interest to the minority stockholders.

Ordinarily every share of voting stock which is recorded upon the books of the corporation entitles its owner to one vote for each of as many directors as are to be elected. For example, if five directors are to be elected, the owner of one share may cast one vote for each of five candidates; in other words, he must divide his five votes among five candidates, one to each.

In the usual application of cumulative voting, however, this stockholder still has his five votes and *may still divide* them among five directors; but, if he wishes, he may cast all five votes for one

* *Journal of Accountancy*, January, 1910; R. J. BENNETT, "Corporation Accounting," p. 36, Ronald Press Company, New York; R. H. MONTGOMERY, "Financial Handbook," p. 566, Ronald Press Company, New York; EARL A. SALIERS, "Accountant's Handbook," p. 799, Ronald Press Company, New York.

candidate or he may divide them between two or more as he desires.

As a concrete illustration of the advantage of cumulative voting to the minority stockholders in securing representation upon the board of directors, suppose a company with a board of five directors has 1,000 shares of stock outstanding, 700 shares of which are held by parties who vote together as a majority and 300 shares held by a combined minority. Without the possibility of cumulative voting, the five candidates favored by the majority would receive 700 votes and would be elected, while the minority candidates would receive 300 votes and would fail of election.

Under the system of cumulative voting, the majority having $700 \times 5 = 3,500$ votes could give five candidates 700 votes each, while the minority voters, having $300 \times 5 = 1,500$ votes at their disposal, could divide them equally between two of their candidates, giving each 750 votes; if the majority voted in the manner suggested, the minority would elect its two directors.

The majority would then have three members of the board and the minority would be represented by two of its candidates.

If, however, the majority divided its 3,500 votes equally among four candidates, giving each 875 votes, or in such a manner that two received 870 and two 880 votes, such plans would surely elect four of the five directors. However, the minority could even then elect one director by concentrating all of its 1,500 votes upon one candidate and the majority could not prevent such a minority representation.

But suppose some general rules based upon the algebra of permutations and combinations of votes be undertaken to cover all possibilities:

First Rule: To find how many votes a stockholder may cumulate upon any specified number of directors.

d = total number of directors to be elected.

n = number of directors to be elected by one group.

st = total number of voting shares outstanding.

s = number of voting shares held by one group.

w = total number of votes that may be cast = dst .

v = number of votes that may be cast by one group = ds .

u = number of directors upon whom it is desired to accumulate votes.

x = the number of votes to be cast for each of such directors.

Then obviously

$$x = \frac{ds}{u} = \frac{v}{u}$$

Or in the previous illustration for the minority:

$$x_{\min.} = \frac{5 \times 300}{2} = 750$$

which is enough to elect two directors if the majority distributes its votes equally.

$$x_{\max.} = \frac{5 \times 700}{5} = 700 \text{ each}$$

Second Rule: To determine the minimum number of votes stockholders must hold or control to elect a specified number of directors.

$$x = \frac{wn}{d+1} + n$$

where n represents the number of directors to be elected. For example, for one director only,

$$x_1 = \frac{5 \times 1,000 \times 1}{6} + 1 = \frac{5,000}{6} + 1 = 834 \text{ votes}$$

Suppose two directors are desired:

$$x_2 = \frac{5 \times 1,000 \times 2}{6} + 2 = \frac{10,000}{6} + 2 = 1,668 \text{ votes}$$

Third Rule: To determine how many directors a certain number of specified votes may elect:

$$n = \frac{v(d+1)}{w+d+1}$$

To illustrate:

$$n = \frac{1,500 \times 6}{5,006} = 1+$$

One director might be elected, but under the second rule a minimum number of 834 votes is needed for one director. Therefore $1,500 - 834 = 666$ votes may be distributed among other candidates of the minority and still be sure of electing one director.

Suppose the majority in the previous problem held only 510 shares or 51 per cent and the minority held 490 shares. If all five directors are up for election, the minority can be sure of electing

$$n = \frac{2,450(6)}{5,006} = 2 +$$

Thus the minority is assured of at least two members of the board and, if the majority were to distribute its votes over more than three candidates, the minority could elect three members and have control of the board.

Thus

$$x_{\text{maj.}} = \frac{510 \times 5}{4} = 637$$

$$x_{\text{min.}} = \frac{2,450}{3} = 816$$

If the board consists of an even number, say six, then the majority with 51 per cent of the voting stock could not be sure of having control of the board.

Since

$$n = \frac{v(d+1)}{w+d+1} = \frac{2,940 \times 7}{6,007} = 3 +$$

the minority could elect half the members and the majority could not prevent it.

As the result of the advantages of this type of voting, several states have provided legislative enactments to the effect that companies operating under their laws may adopt the principles of cumulative voting.

Stocks may be held for many reasons. Primarily, from the very nature of the corporate organization, stocks should be held by those interested in the business and anxious to assist in its management and development. Herein the corporation differs from the partnership. If stockholders are considered for the moment as partners in a corporate management, we find many who take no interest in and know nothing about the business transacted. Thousands of stockholders never vote. The purchase of stock is rather generally looked upon as an investment and the directors and interested stockholders are permitted to run the business. Upon the Stock Exchange stocks are bought

and sold for speculation or for more or less permanent investment. In the majority of such dealings the policies of the corporation are far from the mind of the purchaser unless, perchance, some radical change of policy or lack of business judgment or foresight on the part of the directors has caused a marked change in the value of the stock as listed upon the exchange. Even in such a case the result might be the sale of stock rather than an endeavor to exercise one's influence through one's vote upon the policies of the company.

Considering the purchase of stock for reasons other than interest in the management of the corporation, it may be well to distinguish between investment and speculation. Many stocks are held by conservative investors for the return that such stocks may provide upon the money invested. Such stocks change hands infrequently, remain fairly constant in value, and pay relatively low dividends. Preferred rather than common stock makes up the large portion of such investments as the former carries a predetermined dividend rate.

Less conservative is the investment in fluctuating stocks whether held for their dividends or purchased with the hope of future sale at higher values. Common-stock dividends may vary from quarter to quarter or from year to year and the fascination of much higher returns than are ordinarily paid upon preferred stock attracts the investor who is not absolutely dependent for his living upon stock dividends and who has a little speculative tendency.

The stockholder who buys, not with the expectation of dividends primarily, but rather with the hope of selling at a higher figure, depends upon the increase in value of the stock for his profit. If he can hold the stock indefinitely, until such appreciation takes place, well and good; but if his financial situation is such that he must sell in a limited time, regardless of the quotation upon his stock, the element of chance enters in to a large extent. Such trading is necessarily considered as highly speculative.

The class of stock traders last discussed was assumed to be those who pay for the stock purchased in full. In contrast should be mentioned the *margin trader*, who pays his broker but a small percentage of the price of the stock, thereby trading in many times the number of shares with a given amount of money available. The elements of still greater chance and speculation are

seen to enter such a transaction. As the market value of the client's stock falls, more and more money must be paid the broker to cover his marginal claim on depreciated stock values until finally the buyer may be forced to sell at a loss upon a low market. On the other hand, with a rise of \$1 per share when working upon a 10 per cent margin, the stockholder's profit is \$10 for every \$1 of the conservative investor who avoids marginal trading.

Conversely, the trader may be basing his hope of profit upon a falling market. He is then called a "bear" rather than a "bull." He has really promised or contracted to sell stock at its present value with the hope that he may buy, deliver, and pay for it later upon a falling market and take the difference in price as his profit. Such a trader, working upon a marginal basis, must continue to furnish his broker with more cash to cover his purchases as the stock appreciates in value and may be obliged to purchase the entire stock at a higher figure or to sell with the loss of excess marginal payments made during the period of appreciation.

Trading on a margin may be so carried on as to constitute gambling and may be so recognized under the law. If there is a definite contract to sell certain stock, accompanied by a definite purpose to purchase and deliver the stock at a later date, the contract is valid and quite similar to many industrial contracts. If, however, there is no intention to purchase and make delivery of the stock, but merely to pay the difference between present and future market values of the stock, the law would consider such a procedure as gambling and any such agreement as void.

The fascination of such highly speculative trading, together with the alertness required for studying stock reports, attract many amateur as well as professional traders and tend to vary the personnel of the stockholders of some corporations. As an example of the variation in a few of the stocks of particular interest to manufacturers and utility engineers, a quotation will be found in Table IV and Fig. 4.*

Whether the stockholder purchases his stock merely for speculation, for investment, or as a result of his interest in assisting in framing the policies of the corporation, as soon as one or more shares of the stock have been transferred to him upon the books of the corporation, the stockholder assumes some important

* *Business Week*, Aug. 25, 1934.

TABLE IV.—TYPICAL STOCK AND BOND PRICES
Poor's Public Utilities
(Covering Predepression, Depression, and Postdepression years)

	1926			1927			1928			1929			1930			1931			1932			1933			1934			1935				
	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L				
Alabama Power Co.:																																
7% Pfd.....	109½	106½	115	107	116	110	115	108	115½	109	115½	85	94	61½	68	26	58½	31½	80½	31½	80½	31½	80½	31½	80½	31½	80½	31½	80½	31½		
\$6 Pfd.....	106	98	105½	100	109	96	104½	100	103½	73	85	43	58	25	52	32½	71½	32½	71½	32½	71½	32½	71½	32½	71½	32½	71½	32½	71½	32½		
\$6 Pfd.....	95	92	93½	90	94	93½	93½	90	93½	88	93	60	78	45	51½	17	43	20	*61½	20	*61½	20	*61½	20	*61½	20	*61½	20	*61½	20		
1st Mtge. and Ref. 5's																																
1961.....	101½	97	103½	98½	102	98½	101½	98½	104½	100½	92	92	95½	76	97	54½	83½	59	101½	83½	59	101½	83½	59	101½	83½	59	101½	83½	59	101½	83½
1st Lien and Ref. 5's																																
1956.....	98½	98½	102½	98½	102	98½	105	98	104	100	104½	96½	96½	78	95	55	87½	60	101½	83½	60	101½	83½	60	101½	83½	60	101½	83½	60	101½	83½
1st and Ref. 4½'s 1967.																																
1st and Ref. 5's 1968.....	95½	95	100½	93	96½	90	89½	100	93	99½	79	84½	70	81½	44½	73½	61	90	66½	73	66½	73	66½	73	66½	73	66½	73	66½	73	66½	73
Aurora, Elgin & Chicago:																																
1st 5's 1941.....	100½	98	100½	99½	100½	90	95	70	96½	65	76½	30	*40	8	*25	5	*15	5½	*14	8												
A. T. & T. Co.:																																
Capital stock.....	151	139½	185½	149½	211	172	310½	193½	274½	170½	201½	112½	137½	70½	134½	86½	125½	100½	160½	98½	100½	160½	98½	100½	160½	98½	100½	160½	98½	100½	160½	
Colat. Trust 5's 1946.....	103½	100½	106	102	106	103½	104½	100	106½	102½	108½	96½	107	97½	107½	100	110½	105½	110½	107½	107½	107½	107½	107½	107½	107½	107½	107½	107½	107½		
Conv't. 4's 1936.....	95½	92	102½	93½	100½	92½	98	91½	101½	94½	101½	96½	103	92½	103½	98	104½	101½	104	100½	104	100½	104	100½	104	100½	104	100½	104	100½	104	
Conv't. Deb. 4½'s 1939.....																																
Deb. 5½'s 1943.....	106½	103	109½	105½	110	106	107½	103	109½	104½	111½	99	109	99	109½	99	109½	99	109½	99	109½	99	109½	99	109½	99	109½	99	109½	99		
35 Yr. Deb. 5's 1960.....	101½	97½	107	101	109	103½	105½	100	107½	100½	108½	94	106½	94	106½	94	106½	94	106½	94	106½	94	106½	94	106½	94	106½	94	106½	94		
35 Yr. Deb. 5's 1965.....																																

* High and low bid prices.

obligations. Although, as previously indicated, his responsibility as well as his activity in the management of the business are very much less than in the case of a partnership, yet he immediately becomes liable to the creditors to the extent of the par value of his holdings. In some states or by special charter rulings, the stockholder may be held liable for more than the par value of his stock, but such cases are rare. Stockholders of national banks are responsible for double the par value of their stock. The exact

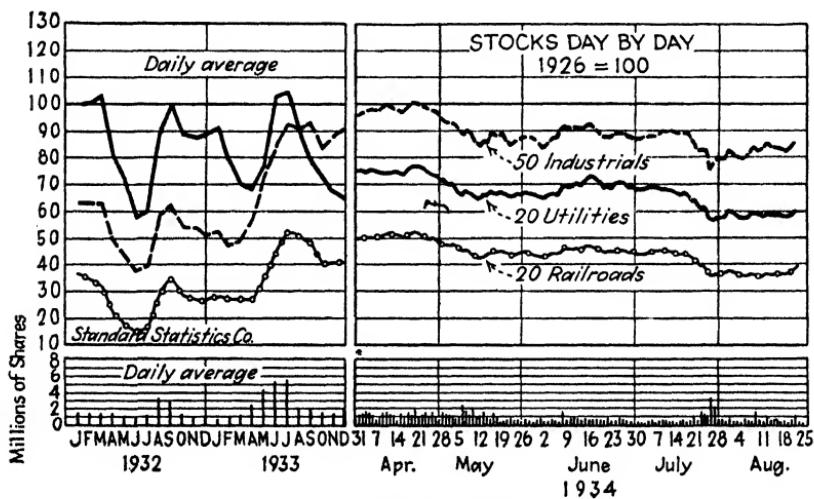


FIG. 4.—Stock-price variation.

wording of this important stipulation of the Federal Reserve Act of Congress of 1913, as amended in 1932, is quoted as follows:

Double Liability of Stockholders. Sec. 2.—The shareholders of every Federal Reserve bank shall be held individually responsible, equally and ratably, and not one for another, for all contracts, debts, and engagements of such bank to the extent of the amount of their subscriptions to such stock at par value thereof in addition to the amount subscribed, whether such subscriptions have been paid up in whole or in part, under the provisions of this Act.

Sec. 23.—The stockholders of every national banking association shall be held *individually responsible* for all contracts, debts, and engagements of such association, each to the amount of his stock therein, at the par value therein, at the par value thereof in *addition to the amount invested in such stock*.

The stockholders in any national banking association who shall have transferred their shares or registered the transfer thereof within sixty

days next before the date of the failure of such association to meet its obligations, or with knowledge of such impending failure, shall be liable to the same extent as if they had made no such transfer, to the extent that the subsequent transferee fails to meet such liability; but this provision shall not be construed to affect in any way any recourse which such shareholders might otherwise have against these in whose names such shares are registered at the time of such failure.

It should be noted that the liability is dependent upon the par value and not the actual amount paid for the stock. The ruling of one court upon this question is as follows:

As between the stockholders who purchased their shares at less than par and the company this was a perfectly valid agreement. It was not forbidden by the charter, or by any laws of public policy, and as between the company and the shareholders was just as binding as if it had been expressly authorized. But the doctrine of this court is that such a contract, though binding upon the company, is a fraud in law upon the creditors, which they can set aside; that where their rights intervene, and their claims are to be satisfied, the stockholders can be required to pay their stock in full.

In states where a par value is not required, the stockholder is responsible for the amount he has agreed to pay or has actually paid for the stock, at a definite price per share.

Although little can be included regarding the relative merits of various stocks and bonds from the standpoint of the investor, a very large and personally varied problem in itself, the concise and fundamental advice of an authority upon the subject may be quoted as a warning to those inclined to plunge into such investments:

Roger W. Babson, the noted statistician and business forecaster, condensed his advice, which has been very seriously considered by many, in a most helpful article in *The Rotarian*, which has since been abstracted by *The Reader's Digest*.*

First, let me question the advisability of handling one's own investment funds without expert advice for which one would directly pay. Do not depend for advice upon the person or firm from which you purchase the securities. Employ some established organization, which has absolutely nothing but service to sell.

* *The Rotarian*, May, 1934, Rotary International, Chicago, and *The Reader's Digest*, June, 1934, p. 83.

Secondly, study fundamental conditions. This does not mean that you must be a statistician or an economist; but you should know whether business as a whole is above or below normal. . . . The time to invest is when these fundamental statistics are abnormally low, showing that the country is in a period of depression, but that the low point has been reached and a slight improvement is constantly taking place. . . .

Thirdly, study public psychology. . . . The American people temperamentally are either very optimistic or very pessimistic. Investors all want to stand on the same side of the boat at the same time. This is one reason why the boat periodically capsizes as it did in 1929. These tragedies occur about once in twenty years (or once a generation) because each generation must learn for itself through bitter experience. The time to invest is when the public is bearish and thinks that good business will never return. . . .

Fourthly, study the volume of transactions as shown on the New York Stock Exchange. . . . These transactions are very important as indicating how far forced liquidation has progressed.

Borrowing and margin trading is the curse of the stock market. The ability to buy stocks on margin pushes the market abnormally high during periods of prosperity; and, conversely, pushes it abnormally low during periods of depression. The time to invest is after the margin accounts have been mostly cleaned out so that there will be no more forced selling. This can be checked by watching the figures on brokers' loans—which figures are published in New York every week.

Fifthly, consider whether inflation or deflation is in progress. . . . When the country is in a state of considerable inflation, it is well to invest a larger proportion in stocks and real estate and a smaller proportion in high-grade bonds. . . .

Sixthly, consider carefully the attitude of managements. There seems to be a *conscientious cycle* as well as a *business cycle*. There are periods when the government, corporation officials, and even courts become careless and indifferent as to honesty, efficiency, and general righteousness. This becomes so bad that at last there is a complete change in public sentiment and the government, boards of directors, and the courts again insist on honesty, efficiency, and uprightness.

Here is the rule to follow in connection with management. *The time to invest in stocks is when the public conscience is demanding honesty, efficiency, and uprightness in corporation officials and directors.*

Seventhly, *avoid debt and margin trading*. Personally, I do not believe in any form of personal debt excepting for goods in the process of manufacture or transit.

Eighthly, *let me urge you to diversify*. *Pin your faith on the business as a whole and avoid being dependent on any one company or any one industry.*

In conclusion, let me remind you that the great losses which have come through the stock market have not come so much from buying *the wrong thing* as from buying at *the wrong time*. Hence my final rule is this: *Invest when you can render a real service to your nation, to industry, and to the unemployed.*

This means that you should not invest during periods of prosperity when all your friends are investing and when there is a surplus of money available. Then is the time when you can best perform a service by liquidating and storing up cash. Every additional person who liquidates during a period of prosperity makes the boom just so much less dangerous, and every person who purchases during a period of depression makes the depression so much less harmful and thereby performs a real service.

It should be emphasized that stockholders are the owners of the corporation. In fact, they are, as a group, the corporation itself. The stockholder who has purchased one or more shares of voting stock (the latter usually being common stock) has thereby secured unto himself a part of the company; he has furnished, in the form of his purchase money expended for stock, a part of the capital with which the company does its business and he has acquired one or more votes at the stockholders' meeting with which he may assert himself and his opinions in the election of directors and in the determination of some of the basic policies of the corporation.

If the business prospers, a portion of the profits (as determined by the directors in the case of common stock and known as dividends) goes to the stockholder as a yield upon his investment in the stock. If such dividends prove to be a fairly high percentage of the stockholders' investments, relatively speaking, when compared with other similar types of investments, the stock becomes recognized as having considerable value upon the market and may frequently be sold at a premium by the original purchaser.

Frequently the purchase of stock by the stockholder is made with the expectation of a rise in value and its subsequent sale at a higher price, rather than for the purpose of securing dividends or the voting power that such stock ownership may provide. Such a procedure is primarily one of speculation rather than that of investment for permanent income or of acquisition of managerial power within the corporation. Such stockholders, although owners of the company, are not particularly interested in its

methods and policies provided the profits and the appreciation of stock values continue.

Customer and Employee Ownership of Stock.—No further attempt will be made here to discuss matters of speculation and the resulting trading upon the stock markets, which represent vast problems in themselves, upon which volumes have been written and in connection with which many sad reactions have been experienced. It may be said, however, that the rank and file of the stockholders, particularly of the public utility companies which have recently endorsed and encouraged customer ownership of their stocks, are more intimately interested in the organization and the success of their corporation than ever before in the history of this form of business enterprise. The story is told of the new and inexperienced stockholding patron of the local electric light company who was criticized by a neighbor for leaving his electric outlets lighted when they were not actually needed. His reply was that it was good business for his company and he wanted to receive a good dividend for the year. Although such a story no doubt exaggerates the interest of the abnormal or ignorant stockholder, the fact remains that the unjust criticisms of public utility corporation management, rates, and quality of service have been greatly reduced by means of this policy of combining the interests of consumer and stockholder.

The electric power companies, and particularly those in and about Chicago, were the leaders in the adoption of this policy. As an illustration of the rapid growth of the practice, it may be stated that, from the eleven stockholders in the company which in 1883 was the predecessor of the present Commonwealth Edison Company of Chicago, the number of stockholders was increased to 2,045 in 1913 and to 7,000 in the year 1919. During this latter year the company first extended a special invitation to customers to become stockholders, with the result that the numbers increased to 15,000 in 1920, 28,000 in 1922, and 42,980 during 1924 in addition to 4,000 employees of the company who were paying for stock that they had purchased on the installment plan. The new stock sold to customers up to this time represented an investment of \$25,000,000. Approximately 200 companies in the electrical utility business were offering such opportunities. Soon the plan spread to the gas companies, 600,000 shares having been sold directly by one New York company to 18,566 pur-

chasers who had oversubscribed four times the actual issue. The American Telephone and Telegraph Company reported at the same period a distribution of its stock among 315,000 stockholders with a total of 425,146 if the subsidiary companies were included. The Chicago Rapid Transit Lines offered \$5,000,000 of "prior preferred stock" to the public, of which \$1,000,000 worth was oversubscribed by 5,800 employees. The remainder was so well distributed as to average but three shares per purchaser.

This plan of extensive sale of stock to customers and employees was one of the results of the stringent economic conditions of the postwar period. During the war both construction and adequate maintenance expenses had been greatly curtailed, but after the signing of the armistice the necessarily increased expansion was met with high money rates, excessive taxes, and high costs of labor, fuel, and equipment of all kinds. Earnings had been reduced in many instances and the old types of stock had become less attractive, especially to the seasoned investor. New methods of financing were necessarily tried. Fortunately the marked success of the Liberty Loan Bond sales during the World War had educated many new small buyers to the purchase of such securities, while the large companies needing a rapidly expanding supply of capital had been made to realize, by the same token, the value of the previously untapped resources of the rank and file of citizenry, who had suddenly learned the fascination of such investments in public utility stocks. Careful estimates place the value of bonds, notes, and stocks sold in the United States during the year 1923 by local public utilities alone at over one and one-half billions of dollars.¹

There are at least two other reasons for the popularity of public utility stocks and their value to such a company if placed with customers as stockholders.

1. Such investors usually desire to purchase a few shares at a time, possibly on the installment plan, and to have more shares of similar types of stock available for purchase when the former are paid for. The continuous demand for new capital by utility companies to provide new equipment and to enlarge service possibilities makes it necessary to have such stock "on sale" almost continuously.

2. The small stockholder is more readily attracted to possibilities of investment in local familiar companies than in those

less well known which operate in some distance place. The fact that a company is located in the local community, where its needs for expansion are obvious and its personnel is well known, is a potent factor tending to influence the success of the customer-stockholder plan.

Employee Sales Methods.—The employee, or perhaps the customer, is not only a stockholder but frequently a stock salesman in addition. During one so-called customer-stockholder drive over 50 per cent of the employees of one company voluntarily acted as stock salesmen. For this extra work they received a commission based upon the number of shares sold. Even with the generous commissions thus paid this direct employee-customer-stockholder sales method frequently proved more prompt and more generally effective and economical than the former methods, which employed bond houses, banks, and brokers for such a campaign. For the sale of large blocks of well-established stock, the sales cost through the broker or bank would, of course, be lower. Many small investors will purchase stock from the well-known employee when they might be fearful of the professional stock salesman or broker. Deferred payments are more readily arranged thus. From one-quarter to one-half of the sales are frequently made upon this partial-payment basis in spite of the fact that the percentage commission paid to the employee-salesman is frequently greater upon all cash sales than upon those involving deferred payments.

Usually the customer and employee stockholders have been preferred stockholders. The most popular type of purchase is a junior preferred stock issue bearing from 7 to 8 per cent dividend. A few large companies have been successful with as low as 6 per cent stocks of a similar type. One large middle-western public utility placed many thousand shares of its stock of the no-par-value variety within the customer-ownership field at \$93 per share. This was considered equivalent to its common stock at \$100 par value. This was accomplished in spite of the fact that "no-par stock" had just previously been recognized as legal by the legislature of the state in which the successful sale was consummated.

Summarizing, the principal advantages of customer ownership of stock are:

1. A new source of supply of capital is opened for the corporation.
 2. A new type of junior financing is provided which may permit the debt to be kept at a reasonably low value and still maintain a properly balanced capitalization structure.
 3. It provides an attractive nonvoting preferred stock which may be used as a method of securing junior capital without extending the voting stock with the accompanying risk of change of managerial policy.
 4. Financing the corporation is carried on at minimum cost.
 5. The credit of the company is usually strengthened by the diversification of stock ownership.
 6. This wide distribution of stock ownership is usually effective in stabilizing of market values of the stock. Manipulation by the minority becomes more difficult with widespread ownership.
 7. More favorable relations will exist between the corporation and a community that is made up of a large percentage of stockholders.
 8. It will increase the intelligent interest of the public in the affairs of the company.
 9. More efficient and economical management will result from the active interest of many customer stockholders.
 10. It should reduce the uncounted millions of "blue-sky" investment losses in which the unwary small stockholder has been caught in the past.
- Very few sound disadvantages have been successfully lodged against the customer-employee-stockholder plan.
- It has been suggested as a possible criticism that this is simply a subterfuge to create sufficient favorable sentiment to neutralize the effect of, or to avoid, regulation and control by state commissions or municipal ordinances. It is hardly probable, however, that the average consumer is likely to be more tolerant of poor service, inadequate facilities, or unreasonably high rates just because he is a stockholder in the company. In fact, his protest is likely to be the more active because of his sense of proprietorship in a company which he desires to have establish a reputation for good service.

It is particularly important that such a program of customer stock ownership be not undertaken unless the company is reasonably sure that it can maintain the established dividend rate under all circumstances. The 1924 report of the Customer Ownership Committee of the National Electric Light Association is quoted upon this point as follows: "The committee feels that conservatism should always be exercised and that every care should be taken to safeguard securities issued in this manner to make sure that their future and stability are amply secured in every way."

Stockholders "Rights."—One of the privileges of those who have previously purchased stock in a corporation is that of preference in the purchase of additional shares of new issues. Such a privilege is known as a "right." It takes the form of a warrant similar to a stock certificate which is issued pro rata; for example, one right to purchase a new share may be allowed for every two to ten shares owned. These rights are transferable and are bought and sold on the market, frequently being in great demand and therefore bringing premium prices immediately preceding a popular stock issue.

Although the theoretical values of such rights may be calculated and may therefore act as an approximate basis for values, as indicated in the following illustration, the question of supply and demand of the new stock and its probable appreciation upon the market and the dividends that it is likely to command will, of course, affect, more than any other factor, the price to be secured for rights that are offered for sale.

Suppose a corporation with 10,000 shares of stock outstanding (\$100 par value) having a market value of \$115 per share proposes to issue 5,000 more shares and offers the old stockholders one right (to buy a new share at par) for every five shares previously owned by them. The calculated value of such a right would therefore be one-fifth of the difference between the value that might be secured on the outside market and the par value that is charged the old stockholders. Or, expressed in round-number totals, the condition would be as follows:

10,000 shares of stock originally at market value...	\$1,150,000
5,000 shares sold at \$100 each.....	500,000
Total value.....	\$1,650,000

$$\text{Value per share} = \frac{\$1,650,000}{15,000} = \$110$$

$$\text{Value to owner of one right} = \frac{\$110 - \$100}{5} = \$2$$

Summary of Stockholders' Privileges.—The stockholder, and particularly the holder of common stock, usually has the right to participate in the management and in the profits of the corporation, to inspect its books under certain restrictions of charter or bylaws, and to restrain the *ultra vires* acts of the corporation. He has a preference in subscribing for new shares of stock as they are offered for sale and in sharing in the assets of the company upon its dissolution. He may transfer stock freely and has the right to have his name appear as that of a stockholder upon the stock books of the corporation. When his stock is full paid, he is entitled to a stock certificate. The stockholder may expect to be notified of and have the privilege of taking part in, either in person or by proxy, all stockholders' meetings and, ordinarily, to cast one vote for each share of stock held in any election of directors and upon any question that may legally come before such a meeting. A stockholder has the right to share, in proportion to the amount of stock owned, in all dividends declared upon the common stock and to subscribe, in like proportion, for any increase of capital stock. If the corporation is dissolved, he may expect to share, in proportion to the amount of stock owned, in any assets remaining after the corporate debts and obligations have been paid.

The holders of preferred stock have all these rights, in addition to their special rights, unless denied, varied, or restricted by the terms of the issue and so indicated in the stock certificate. In most instances, however, the preferred stockholders are limited in their voting powers as previously described.

THE BONDHOLDER

Bonds, generally speaking, do not show the frequent and marked variation in values experienced by stocks. As previously pointed out, their security is greater and their percentage return upon the investment is less. Bondholders, in contrast to the less conservative stockholders, invest in bonds for the secure income the latter will return over a relatively long term of years. There is a considerable amount of trading in bonds,

however, partly as a result of stock market fluctuations. The success of the corporation whose bonds are under consideration, the date of maturity of the bond, the provisions for redemption and refunding, the demand for the product of the corporation, the cost of raw materials, and the general relative conditions of the bond and stock markets affect bond values from time to time to a slight extent. Table IV also illustrates the bond values

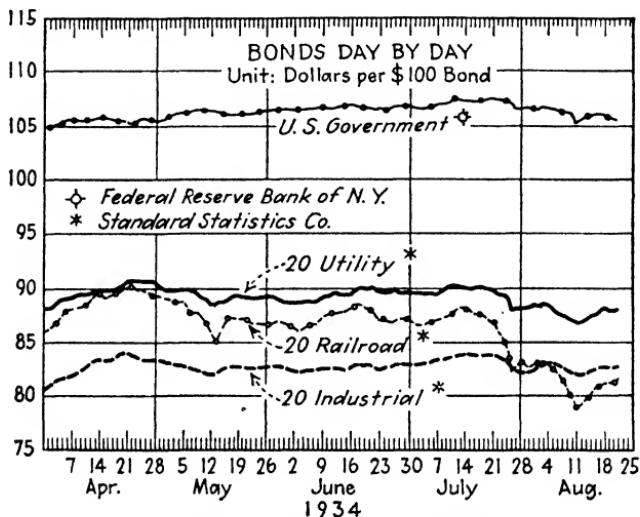


FIG. 5.—Bond-price variations.

of the same utilities, while Fig. 5* shows bond variations in the same market and on the same days as Fig. 4.*

Although it is beyond the scope of this discussion to outline in detail the relative merits of different stocks and bonds, the following advertisements, Tables V and VI, looking toward the sale of new stock and bond issues, indicate the points of particular interest to the prospective purchaser. Security, interest rate, cumulative and participating features, methods of redemption and refunding provided, past history and standing of the corporation, the state in which it is incorporated and corporate laws of such state, market price of issue, etc., are all important features that should be investigated before stocks or bonds are purchased.

* See also Chap. XXI and *Business Week*, Aug. 25, 1934.

TABLE V*

This is not an Offering Prospectus. The offer of these Shares is made only by means of the Offering Prospectus. This is published on behalf of only those of the undersigned who are registered dealers in securities in this State.

This issue, though registered, is not approved or disapproved by the Securities and Exchange Commission, which does not pass on the merits of any registered securities.

200,000 SHARES
STANDARD BRANDS INCORPORATED

\$4.50 Cumulative Preferred Stock
(without par value)

Quarterly dividend payment dates, March 15, June 15, September 15 and December 15.

Redeemable at option of the Company at any time in whole, or from time to time in part by lot, on not less than 30 days' notice, at \$110 per share and accrued dividends. Entitled per share, in preference to Common Stock, to \$100 in involuntary, and to \$110 in voluntary, dissolution, liquidation or winding up, plus accrued dividends in each case.

The following is merely a brief outline of certain information contained in the Offering Prospectus and is subject to the more detailed statements in the Offering Prospectus and the Registration Statement, which also include important information not outlined or indicated herein. The Offering Prospectus, which must be furnished to each purchaser, should be read prior to any purchase of these Shares.

THE COMPANY The Company was organized in 1929 under the laws of Delaware to continue the several long-established businesses of The Fleischmann Company and its subsidiaries, and of E. W. Gillett Company, Limited, Chase & Sanborn, Royal Baking Powder Company, and The Widlar Food Products Company. The Company and its subsidiaries conduct a manufacturing, processing and merchandising business in a large variety of products, primarily food products and foodstuffs, consisting chiefly of yeast and other bakery products sold under the name "Fleischmann" direct to over 30,000 bakers, hotels, and public institutions, and grocery products sold direct to approximately 300,000 grocers and other retail outlets. It is estimated that over half the consolidated net profit from operations is derived from yeast. Their other important products include: Chase & Sanborn Coffee (and other coffees), Tender Leaf Tea (and other teas), Royal Baking Powder (and other baking powders), Royal Desserts, Fleischmann's Gin, malted grains and vinegar. The advertising of items sold under trade names is of great importance, and expenditures for this purpose constitute a very substantial part of the Company's selling costs.

* The Milwaukee Journal, June 23, 1937.

TABLE V.—(*Continued*)

Over 90% of the dollar sales in 1936 were made in the United States and over 95% in the United States and Canada combined. New lines of products may be added from time to time.

Hearings have been held in a proceeding against the Company and a subsidiary before the Federal Trade Commission, under the Robinson-Patman Act, on a complaint alleging certain unlawful price discriminations in the sale of yeast. The Company denies any unlawful discrimination. If the Commission's decision should require a substantial change in present price differentials or in present selling practices, there might be a substantially adverse effect on the Company.

The Company and subsidiaries own or lease a large number of manufacturing, processing and selling units, in widely scattered localities throughout the United States, and in Canada and certain other countries.

CAPITALIZATION The Company has no funded debt. As of December 31, 1936, there were outstanding 70,693 shares of \$7 Cumulative Preferred Stock, Series A, without par value, and 12,645,423 shares of Common Stock, without par value, stated value \$2 per share. In addition, 1,369 shares of Preferred Stock and 3,218 shares of Common Stock were reserved for issuance pending the merger of a subsidiary, which became effective April 8, 1937. All of the \$7 Cumulative Preferred Stock, Series A was called for redemption on June 1, 1937. The only capital securities now outstanding are 12,648,108 shares of Common Stock.

PURPOSE The net proceeds from the sale of the 200,000 shares of \$4.50 OF ISSUE Cumulative Preferred Stock (estimated at \$18,341,950 after deducting expenses) will be used in part to pay the principal of temporary bank loans of \$8,700,000 incurred on May 6, 1937, for redemption of the Company's 72,061 shares of \$7 Cumulative Preferred Stock, Series A. The remainder of the net proceeds (estimated at \$9,641,950), no part of which has been allocated to specific uses, will be added to working capital. It is possible that part of it may be used for the acquisition or improvement of plants, equipment or other property or businesses.

EARNINGS The tabulation of results of operations of the Company and its subsidiaries consolidated (compiled from figures audited by Haskins & Sells) is taken from the Offering Prospectus and is subject to the more complete notes and comments therein as shown in the table on page 77.

Unaudited figures for the first three months of 1937 show consolidated net sales of \$31,095,991 and consolidated net income of \$2,824,551, as against consolidated net sales of \$27,005,387 and consolidated net income of \$3,773,229 for the corresponding period of 1936. These figures are computed on the same basis as those in the following tabulation, but before providing for surtax on undistributed profits, if any.

TABLE V.—(Continued)

\$4.50 CUMULATIVE PREFERRED STOCK The total amount of Preferred Stock authorized is 350,000 shares, issuable in series, certain terms of which may be established by the Board of Directors. The 200,000 shares of \$4.50 Cumulative Preferred Stock constitute the only series now established. Dividends on Common Stock (other than dividends payable in stock of any class) may be declared only out of aggregate consolidated net earnings accruing subsequent to January 1, 1937 available therefor, plus \$5,000,000.

	Net Income before Depreciation, Federal and Foreign Income Taxes, and Amorti- zation of Patents	Provision for Depre- ciation†	for Federal and Foreign Income Taxes	Amortiza- tion of Patents	Net Income as per Accounts‡
4 Mos. 1929	\$ 26,808,586	\$ 6,546,347	\$ 798,412	\$ 491,683	\$ 97,881
Year 1930	89,759,575	21,309,361	2,738,515	2,168,592	287,878
" 1931	88,272,143	*19,259,549	2,635,707	2,081,522	284,577
" 1932	83,534,573	19,430,106	2,459,380	1,969,235	262,210
" 1933	83,281,438	19,291,002	2,025,700	2,216,507	222,424
" 1934	100,449,057	17,874,161	1,800,622	2,195,517	244,443
" 1935	102,040,080	16,725,733	1,857,865	2,122,905	266,204
" 1936	114,975,651	19,171,990	1,633,182	2,811,359	256,055
					14,471,394

* After extraordinary charges: foreign exchange adjustment, \$524,692; and inventory adjustment, \$1,100,000.

† The provisions for depreciation of property for certain years have been subsequently reduced, the adjustments being credited to surplus, and provisions for the resulting additional income taxes have been charged to surplus.

‡ Net Income, as stated above, differs from that of published statements through deductions of yearly charges for amortisation of patents which were not made in published statements. The Company has, since organisation, consistently stated the value of all intangibles at \$1.00 on its published statements, charging off their book value against surplus.

At all meetings of stockholders holders of Preferred Stock and Common Stock are entitled to one vote for each share held. Whenever Preferred dividends shall be in arrears in an amount equal to the annual dividend and until all accumulated dividends shall have been paid or set apart for payment, holders of the Preferred Stock shall also have the exclusive right to elect two directors. Neither the Preferred nor the Common Stock has any preemptive rights.

The Certificate of Incorporation, as amended, provides in effect that the Company shall not create any class of stock senior to the Preferred Stock without the approval, given in the manner provided in such Certificate, of the holders of two-thirds of the Preferred Stock; and shall not adversely amend any of the preferences, special rights or powers thereof, increase the authorized number of shares thereof, create any class ranking pari passu therewith, or incur or guarantee funded debt (with the exceptions provided in the definition of funded debt contained in such Certificate), without the approval, given in like manner, of the holders of a majority of the Preferred Stock.

The foregoing brief outline of the stock provisions is subject to the more detailed statement in the Certificate of Incorporation, as amended,

TABLE V.—(Continued)

which is included in the Registration Statement and summarized in the Offering Prospectus.

UNDERWRITING Subject to certain terms and conditions, the Underwriters named in the Offering Prospectus have severally agreed to purchase these Shares from the Company for delivery and payment on or about June 30, 1937, but not later than July 13, 1937, at \$92.25 per share, or a total of \$18,450,000, plus accrued dividends. Such Shares are to be offered to the public at \$95.00 per share, or a total of \$19,000,000, plus accrued dividends. The underwriting discount is \$2.75 per share, or a total of \$550,000.

Price \$95 per Share
plus accrued dividends from June 15, 1937

The Underwriters, including the undersigned and the others named in the Offering Prospectus, have agreed to purchase these Shares on the terms and conditions set forth in the Purchase Agreement, including approval of legal matters by Messrs. Winthrop, Stimson, Putnam & Roberts, counsel for the Underwriters. It is expected that delivery of definitive certificates for the Preferred Stock will be made at the office of J. P. Morgan & Co. on or about June 30, 1937, against payment therefor in New York funds.

As more fully set forth in the Offering Prospectus, the Underwriters have authorized the purchase and sale, in the open market or otherwise, of Shares for their several accounts, either for long or short account, within the limits and during the period set forth in Agreements therein referred to.

Further information, particularly financial statements, is contained in the Registration Statement on file with the Securities and Exchange Commission, and in the Offering Prospectus which must be furnished to each purchaser and is obtainable from only such of the undersigned

as are registered dealers in securities in this State.

MORGAN STANLEY & CO.

Incorporated

THE FIRST BOSTON CORPORATION

BROWN HARRIMAN & CO. EDWARD B. SMITH & CO.

Incorporated

MELLON SECURITIES CORPORATION

KIDDER, PEABODY & CO. W. E. HUTTON & CO.

LEE HIGGINSON CORPORATION BLYTH & CO., INC.

LAZARD FRÈRES & COMPANY

Incorporated

Dated June 23, 1937

TABLE VI*

This is not an Offering Prospectus. The offer of these Debentures is made only by means of the Offering Prospectus. This is published on behalf of only those of the undersigned who are registered dealers in securities in this State.

This issue, though registered, is not approved or disapproved by the Securities and Exchange Commission, which does not pass on the merits of any registered securities.

\$175,000,000
(of which \$150,000,000 are publicly offered)

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

Twenty-five Year 3½% Debentures

Dated October 1, 1936 Due October 1, 1961
Interest payable April 1 and October 1 in New York City

Coupon Debentures in denominations of \$1,000 and \$500, registerable as to principal. Registered Debentures in denominations of \$1,000, \$5,000, \$10,000, and \$100,000. Coupon Debentures and registered Debentures, and the several denominations, interchangeable.

Redeemable, at the option of the Company, in whole or in part, upon at least 60 days' notice, on any interest payment date, at the following prices with accrued interest: to and including October 1, 1941, 107½%; thereafter to and including October 1, 1951, 105%; thereafter to and including October 1, 1957, 102½%; and thereafter, 100%.

The following is merely a brief outline of certain information contained in the Offering Prospectus and is subject to the more detailed statements in the Offering Prospectus and the Registration Statement, which also include important information not outlined or indicated herein. The Offering Prospectus, which must be furnished to each purchaser, should be read prior to any purchase of these Debentures.

THE COMPANY American Telephone and Telegraph Company, incorporated in New York in 1885, and its telephone subsidiaries are engaged principally in furnishing communication services, mainly telephone service, in the United States. The properties of the Company consist mainly of toll lines and toll switchboards, and those of its telephone subsidiaries consist mainly of exchange and toll lines, switchboards, buildings, telephone instruments and related equipment. The Company and its telephone subsidiaries are subject to regulation by the Federal Communications Commission and by public service commissions or state or local authorities, within their respective jurisdictions. The Federal Communications Commission is presently engaged

* *Indianapolis Star*, Oct. 14, 1936.

TABLE VI.—(Continued)

in an investigation of the Company and its subsidiaries. Western Electric Company, Incorporated, a non-telephone subsidiary, is engaged principally in the manufacture of telephone apparatus and equipment about 90% of which is sold to the Company and its telephone subsidiaries.

CAPITALIZATION	Outstanding as of June 30, 1936
Funded Debt of subsidiaries consolidated.....	\$ 437,594,275
Notes Sold to Trustee of Pension Funds—subsidiaries consolidated.....	114,373,295
Funded Debt of the Company.....	440,943,600
Notes Sold to Trustee of Pension Fund—Company.....	11,022,113
Preferred stocks of subsidiaries consolidated—held by the public.....	104,311,530
Common stocks of subsidiaries consolidated—held by the public.....	86,709,953*
Capital Stock (18,675,283 shares, par value \$100) of the Company†.....	1,867,528,300

* Represents par or stated value.

† As of June 30, 1936, there were 11,559 shares under subscription at \$150 per share by employees (including officers) of the Company and of certain other corporations to which the Employees' Stock Plan was extended. 129,230 shares are authorized for issuance to cover conversions of certain bonds of the Company.

PURPOSE The net proceeds, exclusive of accrued interest, from the sale of issue of the Debentures, after deducting the estimated expenses of the Company in connection with such sale, are expected to approximate \$172,710,000 and are to be applied toward the retirement of the Company's presently outstanding issue of \$117,984,700 of Thirty-five Year Sinking Fund 5% Debentures, due January 1, 1960, which the Company intends to call for redemption on January 1, 1937, at 110% of their principal amount (\$129,783,170) and accrued interest; and toward the retirement of the Company's presently outstanding issue of \$64,865,200 of Thirty Year Five Per Cent Collateral Trust Bonds, due December 1, 1946, which the Company is calling for redemption on December 1, 1936, at 105% of their principal amount (\$68,108,460) and accrued interest. The Company expects to obtain the balance (approximately \$25,182,000) of the requirements for such redemptions, exclusive of accrued interest, from its current cash and temporary cash investments.

EARNINGS The following figures are taken from the Consolidated Income Statements of the Company and its principal telephone subsidiaries in the Offering Prospectus and must be read in conjunction with such income statements and the notes appended thereto. The Offering Prospectus also contains separate Income Statements of

TABLE VI.—(Continued)

the Company. The Registration Statement contains, in addition to the foregoing, Consolidated Profit and Loss Statements of Western Electric Company, Incorporated, and its 100% directly-owned subsidiaries.

	Six Months Ended			
	June 30, 1936	Year 1935	Year 1934	Year 1933
Operating Revenues.....	\$488,870,271	\$919,116,223	\$869,525,401	\$853,825,376
Net Operating Income....	\$104,806,678	\$183,160,747	\$175,042,544	\$165,969,789
Other Income.....	11,583,352	14,346,928	5,596,902	157,067*
Total Income.....	\$116,390,030	\$197,507,675	\$180,639,446	\$165,812,722
Interest and Other Deductions.....	31,310,177	64,589,182	69,332,407	65,304,258
Consolidated Net Income. \$ 85,079,853	\$132,918,493	\$111,307,039	\$100,508,464	

* Negative amount.

The figures for 1934 reflect adjustments made in various accounts in connection with refunds ordered in certain rate cases.

Provision, if any required, for Federal surtax on undistributed earnings for 1936 cannot be determined until the end of the year.

Other Income includes dividend, interest and miscellaneous income of the consolidated group. It also includes the proportionate interest of the companies comprising the consolidated group in the earnings or deficits (after dividends) of all subsidiaries not consolidated, including Western Electric Company.

DEBENTURES The Twenty-five Year 3½% Debentures will be issued under an Indenture dated as of October 1, 1936 between the Company and Central Hanover Bank and Trust Company (New York City), Trustee. This issue of Debentures is not secured. It is limited to \$175,000,000 but the Indenture does not limit the amount of other securities or indebtedness, either secured or unsecured, which may be issued or incurred by the Company or by subsidiaries of the Company. The Indenture contains a covenant that if the Company shall pledge as security for any indebtedness or obligations any stock, owned by it at the date of said Indenture or thereafter acquired, of any telephone corporation doing business in the United States of America, or of any corporation owning 50% or more of the voting securities of any such telephone corporation, the Company will secure the outstanding Debentures of this issue ratably with the indebtedness or obligations secured by such pledge.

UNDERWRITING Subject to certain terms and conditions, the Underwriters named in the Offering Prospectus have severally agreed to purchase an aggregate of \$150,000,000 of these Debentures from the Company at 99%, or a total of \$148,500,000, plus accrued interest. Such Debentures are to be offered to the public at 101%, or a total of \$151,500,000, plus accrued interest. The underwriting discounts are 2%, or a total of \$3,000,000. There is no firm commitment for the remaining \$25,000,000 of Debentures, but the Company is withholding such Debentures for sale, on or before January

TABLE VI.—(Continued)

1, 1937, only to the Trustee of Pension Funds established by the Company and by certain of its subsidiaries, without underwriting discounts or commissions, at 99%, or a total of \$24,750,000, plus accrued interest.

Price 101% and Accrued Interest

The Underwriters, including the undersigned and the others named in the Offering Prospectus, have agreed to purchase \$150,000,000 of these Debentures on the terms and conditions set forth in the Purchase Agreement, including the approval of legal matters by Messrs. Davis Polk Wardwell Gardiner & Reed, counsel for the Underwriters, and Mr. Charles M. Bracelen, counsel for the Company. It is expected that delivery of Debentures in temporary form will be made at the office of J. P. Morgan & Co. on or about October 22, 1936, against payment therefor in New York funds.

As set forth in the Offering Prospectus, the Underwriters have authorized the purchase and sale, in the open market or otherwise, of Debentures for their several accounts, either for long or short account within the limits and during the period set forth in the Agreement between themselves.

Further information, particularly financial statements, is contained in the Registration Statement on file with the Securities and Exchange Commission, and in the Offering Prospectus which must be furnished to each purchaser and is obtainable from only such of the undersigned as are registered dealers in securities in this State.

MORGAN STANLEY & CO.

Incorporated

KUHN, LOEB & CO. KIDDER, PEABODY & CO.

LEE HIGGINSON CORPORATION

THE FIRST BOSTON CORPORATION

BROWN HARRIMAN & CO. EDWARD B. SMITH & CO., Inc.

Incorporated

Dated October 15, 1936

The bondholder fulfills quite a different relation to the corporation from that of the stockholder. The bondholder is a creditor; the stockholder is an owner and therefore debtor to the bondholder. Only the stockholder may vote. The bondholder does not necessarily interest himself in any of the proceedings of the corporation so long as his interest is paid regularly and the bonds maintain a reasonable market value. Bonds are purchased as a long-term conservative investment at moderate interest and the necessity of reinvesting is looked upon with concern and reluctance.

Bonds, as in the case of stocks, may be purchased at a premium or discount. Some investors, desiring a particular bond paying good interest and likely, in their opinion, to appreciate in value, may feel justified in paying \$105 for a \$100 bond. The interest return upon their particular investment is, of course, reduced in proportion. Similarly, if a bond of the same face value, paying 4 per cent interest, may at some favorable time be purchased at

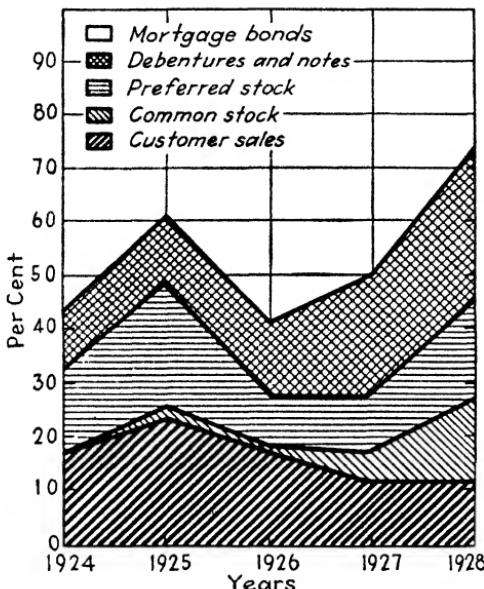


FIG. 6.—Proportion of the different types of securities making up the total of the electric light and power corporations.

80, the interest return becomes \$4 per year upon an investment of only \$80, which is the equivalent of 5 per cent. With equal security and the same date and conditions of maturity, this is equal to a 5 per cent bond purchased at par value.

Referring again to the needs of public utility corporations for borrowed money, the accompanying Tables VII* and VIII† illustrate very well the relation between the various types of stocks, notes, and bonds which were issued by such companies during the years 1928 and 1936, respectively, as well as the amount of the issues and the interest and dividend rates to be paid thereon. Figures 6 and 7 indicate graphically the propor-

* *Elec. World*, vol. 93, no. 1, Jan. 5, 1929.

† *Ibid.*, vol. 107, no. 1, Jan. 2, 1937.

TABLE VII.—ELECTRIC LIGHT AND POWER SECURITIES SOLD IN 1928*

Number of issues	Range of yield, per cent	Amount of issues
Mortgage bonds (average yield 4.69 per cent)		
8	4.40 to 4.59	\$108,500,000
10	4.60 to 4.80	73,508,100
13	4.81 to 5.00	44,072,000
9	5.02 to 5.10	49,850,000
8	5.12 to 5.23	42,020,000
9	5.25 to 5.35	39,600,000
14	5.40 to 5.70	37,825,000
6	5.75 to 5.80	19,100,000
13	6.00 to 6.50	21,335,000
90	.....	\$ 435,810,100
Debentures (average yield 5.22 per cent)		
4	4.73 to 5.00	\$140,650,000
5	5.13 to 5.28	94,000,000
7	5.30 to 5.60	99,000,000
6	5.75 to 6.00	61,700,000
9	6.03 to 6.50	24,938,000
31	.....	\$ 420,288,000
Notes (average yield 5.75 per cent)		
6	5.00 to 5.50	\$ 11,675,000
7	5.63 to 6.00	48,300,000
4	6.04 to 6.17	6,025,000
17	.....	\$ 66,000,000
Preferred stock (average yield 5.74 per cent)		
6	5.00 to 5.20	\$ 67,920,000
7	5.25 to 5.82	50,172,000
9	5.85 to 6.00	75,053,852
7	6.03 to 6.15	35,349,500
8	6.18 to 6.38	23,739,500
6	6.40 to 6.93	14,405,000
7	7.00 to 7.21	10,245,000
50	.....	\$ 276,884,852
Common stock		
5	.....	\$ 38,237,500
Rights and warrants..	.....	234,277,057
Total of all issues of year.....		\$1,471,497,509
Estimated local sales to customers.....		170,000,000
		\$1,641,497,509

TABLE VIII.—NEW UTILITY FINANCING DURING THE YEAR 1936
TOTALS \$1,290,106,163*

Number of issues	Range of yield, per cent	Amount of issues
Mortgage bonds (average yield 3.14 per cent)		
8	3.04 to 3.17	\$ 196,067,000
15	3.23 to 3.35	346,401,500
9	3.40 to 3.57	81,370,000
13	3.60 to 3.90	293,575,900
9	4.00 to 4.77	98,542,800
4	Placed privately	96,000,000
58	.....	\$1,111,957,200
Debentures (average yield 3.30 per cent)		
6	2.75 to 3.95	92,700,000
3	4.19 to 5.00	8,800,000
1	.....	1,500,000
10	.....	\$ 103,000,000
Notes (average yield 1.79 per cent)		
2	1.87 to 2.74	2,290,000
2	3.00 to 3.10	11,600,000
1	Placed privately	9,000,000
5	.....	\$ 22,890,000
Preferred stock (average yield 3.80 per cent)		
4	4.39 to 4.90	33,958,828
3	5.14 to 5.33	2,622,635
2	.....	8,552,500
9	.....	\$ 45,133,963
Class A stock		
1	.....	\$ 7,125,000
Total financing.....		\$1,290,106,163
Refunding.....		1,245,360,858
New capital.....		44,745,305

* *Elec. World*, Jan. 2, 1937.

tion of the different forms of capital which have made up the totals for the electric light and power corporations during the four years preceding and the seven years subsequent to the 1929 panic, respectively.

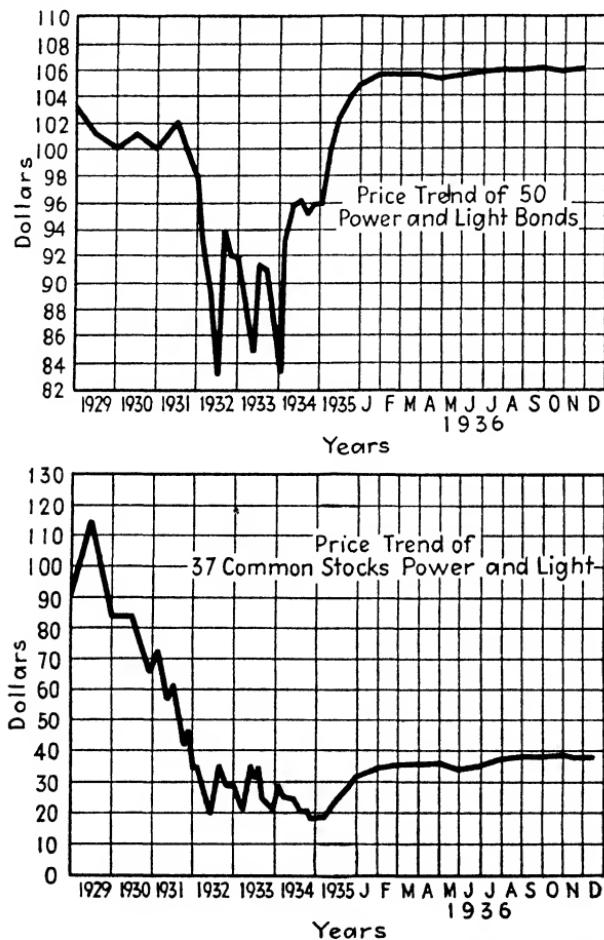


FIG. 7.—Price trends of power and light stocks and bonds.

As an explanation of the trend, during the year 1928, clearly shown in these charts, toward the raising of relatively more funds by the sale of stocks and other unsecured obligations, *Electrical World* may be quoted to advantage as follows:

Such a process has been aided by the passage of the Wales act legalizing utility preferred stocks and debentures for certain classes of invest-

ments. Life insurance companies, formerly restricted to mortgage bonds, mortgages, and government obligations, may now invest in preferred and guaranteed stocks whose earnings comply with certain fixed standards. That change brings into the eligible field many issues of debentures and preferred stocks of both holding and operating companies which were not formerly purchasable by such companies. This undoubtedly is one factor in the very noticeable shift away from mortgage-bond financing, of which the 1928 total was \$435,810,000, against \$1,107,670,000 in 1927, and a corresponding increase in equity and unsecured obligation financing. Against 50 per cent of the total in 1927, mortgage bonds accounted for but 27 per cent last year. Debentures and notes combined increased from 23 to 29 per cent. Preferred-stock financing increased its proportion of the total from 10 to 17 per cent, while common stock, including rights and option warrants, rose from 6 to 16 per cent. Sales of stocks direct to customers, as discussed in detail elsewhere, retain the same proportion of the total, but have declined in dollar value from \$263,527,300 to \$170,000,000.

In contrast to the stockholder who is the owner of the company is the bondholder who is a creditor of the company. The bondholder loans money to the company for a definite rate of interest. As an evidence of the loan he holds one or more bonds which may be of the various types previously described. He is interested only in the company to the extent of its ability to pay interest or possibly the market price of the bonds from time to time. He has no vote and no voice in the management of the company as long as his bond interest is paid regularly. In fact, he is not particularly interested in the possibility of payment by the company of preferred-stock or common-stock dividends for his claim for bond interest is a prior claim to that of any stockholder. A corporation, like an individual, must pay its debts before it may enjoy a profit. Bond interest is a debt; stock dividends take the form of a profit. The stockholder cannot enforce the payment of dividends as the bondholder can his interest.

Since the bondholder is loaning money to a corporation, usually for a long term of years, he is vitally interested in the security back of the bond and even in the priority or sequence of return payments of his loan which the corporation must make to him in case of failure of the business or upon the date of maturity of the particular bond issue.

Generally speaking, and aside from government bonds, those of best security are mortgage bonds. Although the principle of

such protection to the bondholder is not unlike that enjoyed by the holder of a complete private mortgage upon some small unit of real estate, yet the advantage of the bond issue lies in its possibility of subdivision into small amounts or loans. These are flexible and readily marketable even though protected by a single mortgage upon a large value of company property.

THE TRUSTEE

The relation between the individual bondholder and the company, however, usually involves a third party, known ordinarily as the trustee. To the trustee is assigned the one mortgage issued and recorded upon the property, which mortgage protects all fractional denominations thereof in the form of bonds purchased by the bondholders. It is the duty of the trustee to see that the property is properly conserved and that the funds of the corporation available for bond interest and for the redemption of the issue at maturity are thus applied. If this is not done by the corporation, it is the duty of the trustee to take legal action to protect the bondholders. Normally, i.e., so long as corporate obligations are met, the trustee devotes little attention to the problem. At all times he represents the bondholders legally but becomes active in case of foreclosure of the mortgage.

Trust companies usually act as trustees as they have greater facilities and experience than an individual in representing the bondholders. They have great powers delegated to them in the mortgage and bond agreements and by state statutes. They assume, therefore, formidable responsibilities in behalf of the bondholders. Their legal accountability, however, applies only to any lack of faithfulness in the exercise of their powers.

The chief powers, rights, and obligations of the trustee have been well summarized by Lagerquist as follows:²

1. To certify the bonds issued upon the mortgage under his trusteeship.
2. To see that interest charges and principal are paid when due.
3. To keep a check upon the physical condition of the property.
4. To see that the funds belonging to the mortgage holders are not dissipated.
5. To seize the property of the corporation under authority of the court when either principal or interest is not paid, provided this power

exists, whether by statute or provision in the mortgage where such is allowable by law.

6. To bring foreclosure proceedings and to request the court to appoint a receiver, if either interest or principal is not paid.

7. To sell the property in case of foreclosure, without operating it, if the mortgage expressly so provides.

Special conditions affecting the trustee are:

1. When a trustee is doubtful as to the method of procedure, he should appeal to the court for guidance.

2. He may seek legal counsel and not be liable for accepting this advice where he is following it in good faith.

3. If the mortgage deed states that any actions of the trustee shall be governed by a specified vote of the bondholders, both the trustee and all bondholders are governed by such vote.

4. The trustee may be removed for any willful acts of either omission or commission that injure the rights of the bondholder.

5. A trustee cannot resign without the consent of both the bondholders and the corporation, except where his resignation is expressly provided for in the mortgage.

6. The compensation of the trustee may be fixed by common agreement or by the mortgage; all reasonable expenses in carrying out duties of the trusteeship are always allowed by law.

Since the trustee acts legally for the bondholder, the latter is bound by the acts of the trustee. The only remedy is the application by the bondholders to the court for removal of the trustee if evidence of negligence or illegal transactions is presented. In case of removal of the trustee by the court, a representative selected by the majority of the bondholders may take his place.

When a corporation fails to pay interest or principal when due or when it fails to meet any other requirement stipulated in the mortgage agreement, the control of the corporation passes to the trustee. Most mortgage agreements require, however, a majority vote of bondholders before a trustee may declare the default and the consent of a certain number of bondholders is usually required before the trustee may institute further legal proceedings such as sale of property, etc. Thereafter the trustee may proceed with foreclosure sale at once or he may operate the property until such time as he considers more opportune for sale.

Bondholders always have the right to ask the courts for foreclosure even if such action is not provided for in the mortgage. Numerous instances are on record, however, wherein the bond-

holders have waived the right to foreclose and to sell the corporate property even when interest has not been earned by the corporation for several years. Such a decision has usually resulted from the belief that more efficient management or better financial conditions to be expected in the future might provide better values for their bonds than would be the case with the immediate shrinkage in values which seemed inevitable from a forced sale of the property. This condition is particularly true of corporations such as railroads, mines, etc., where physical property values behind the mortgage have been depreciated and where such property values were of minor status when compared with the total valuation of the company as a going concern which would enjoy a valuable patronage only when operating as such.

In such cases the trustee will probably not sell or operate the property but the court may appoint a receiver for the latter purpose. If the corporation, thus operated, is not able within a reasonable time to meet the requirements of the court and pay to the bondholders and other creditors the amounts decreed by the courts as due them (which amounts are usually less than the bondholders original investment), the property may be sold at public sale.

Frequently the bondholders in self-defence will deposit their bonds with a committee which they appoint. This accumulation of bonds accompanied by consolidated action often makes possible the purchase of the property by the committee and the reorganization of the business. Such a procedure, unless carefully watched and safeguarded, sometimes favors a portion of the bondholders to the disadvantage of others. Herein the individual bondholder must, if possible, ascertain the policies of the committee and make sure that such a committee is representative and not hastily selected to the advantage of the few who have more intimately interested themselves in the proceedings.

Such are the important relations of the bondholder to the corporation in cases of failure of the business to complete its obligations to those from whom it has borrowed money. The majority of bonds, especially of the well-established large corporations, never reach such a condition. The bondholder, therefore, although ever alert in the study of such possibilities of default of payment, will ordinarily be called upon to familiarize himself with the peculiarities of his function as a bondholder.

under normal conditions of purchase, appreciation and depreciation of values, relative yields, etc., as contrasted with the ownership of stock or the holding of a promissory note.

Contrary to the conditions of a personal note, the vendor of a bond does not guarantee either the legality of the bond issue or the payment of the bond at maturity. As far as his knowledge of the bond is concerned, it is sold for what it purports to be on its face. He states or implies that he has obtained it for valuable consideration and that he is legally competent to transfer it to the purchaser. A bond is negotiable or partially so and is not subject to the defenses that would exist between the parties to a promissory note loan. The bona fide holders of bonds are usually rigorously protected by the courts in accordance with the face values and the statements made thereon. The fact that a bond may have been purchased below par value does not change such an interpretation by the court.

The holder of a first-mortgage bond may claim the priority implied by the first-mortgage features thereof even though his bond may have been issued and purchased subsequent to a second- or third-mortgage bond upon the same property. A bondholder may not claim superior rights over others of later dates of issue or serial numbers unless such superior rights are specifically stipulated in the bond itself or expressly provided for in the deed of trust. Payment by the corporation of money loaned by the bondholder may not be claimed previous to maturity of the bond unless there is a specific provision in the bond for such earlier redemption. This statement refers to payment and consequent retirement and cancellation of the bond by the issuing corporation and has no bearing upon the sale of the bonds upon the market or upon private sale among bondholders or upon the purchase by the issuing corporation of its own bonds in the open market prior to maturity.

A bondholder may ordinarily bring suit to secure the money he has loaned if it is not paid by the debtor company at maturity, just as in the case of an unpaid promissory note. This is usually possible even though the mortgage securing the bond is not foreclosed. However, such a suit by individual bondholders before foreclosure is not legal in some states.

The Privileges of the Bondholder.—Briefly summarizing the relations expressed in this chapter, the owners of the corporation

are furnishing a portion of the capital by the purchase of one or more of the many possible varieties of stock described in an earlier chapter. Thereby they become stockholders (voting or non-voting, depending upon the class of stock purchased). They secure yields thereon of conservative amounts obligatory upon the company in the case of preferred stock or they accept yields varying over wide ranges depending upon the conditions and management of the business in the case of common stock.

The corporation, in turn, may borrow a portion of its capital from bondholders who purchase bonds with varying conditions of security and usually with inverse ratios of possible yield. Such bondholders are creditors and as such are protected by law against the undermining of their basic securities in the form of mortgages.

The trustee, usually a trust company, is in turn the intermediary between the corporation and its creditor bondholders and is under legal obligations as well as bond and mortgage stipulations to protect the prior interests of the bondholder in case of default of payment, by the corporation, of either interest or principal.

Specific References

1. OULSEN, W. H., JR.: *Nat. Elec. Light Assoc. Bull.*, April, 1924, p. 204.
2. LAGERQUIST, WALTER EDWARD: "Investment Analysis," p. 121, The Macmillan Company, New York.

General References

- CONYNGTON, THOMAS, R. J. BENNETT, and PAUL W. PINKERTON: "Corporation Procedure," Ronald Press Company, New York.
MONTGOMERY, R. H.: "Financial Handbook," Ronald Press Company, New York.
SALTERS, EARL A.: "Accountant's Handbook," Ronald Press Company, New York.

Review Questions

1. Discuss the privileges normally enjoyed by stockholders.
2. What effect may a voting trust have upon the initiative of the individual voters?
3. Company A has eight members on its board of directors and has 10,000 voting shares of stock outstanding, of which 6,000 may be relied upon to vote as a majority and the balance as an organized minority. Four of the eight members are up for election at the annual stockholders meeting where accumulative voting is required by the bylaws.
 - a. How many directors can the minority elect if the majority does its utmost to prevent the election of any candidates by the minority?

- b. How many directors could it elect if the majority distributes its votes equally among all four?
 - c. Repeat (a) and (b) if an entire new board is to be elected.
4. Company B has 10,000 voting shares outstanding, of which Mr. X controls 51 per cent. The balance is owned by various other people. If the board of directors consists of ten members, all of which are up for election, how many can Mr. X be sure of electing?
5. Company C has 15,000 shares of stock outstanding. This stock has a par value of \$100 and a market value at this time of \$120. This company plans to issue 10,000 more shares and offers each of its old shareholders one right for every ten shares owned by them. Mr. Y owns 1,000 shares of the old stock but does not wish to purchase any more. Calculate the minimum sum Mr. Y should obtain for all his stock rights.
6. Discuss the advantages of customer ownership of stocks.
 7. Discuss the advantages and disadvantages of employee sales methods of selling stocks of the company by which they are employed.
 8. Distinguish carefully between the bondholder and the stockholder.
 9. What detrimental effect might a shift from stockholders to bondholders have upon the corporation?
 10. What detrimental effect might a shift from bondholders to stockholders have upon the corporation?
11. Outline some of the characteristics of public utility securities as contrasted with "industrials." What are some factors that would indicate soundness of securities in the public utility field?
12. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:
- T F Bonds sold at a premium pay a higher yield on investment therein than the rate prescribed in the bond itself.
- T F Cumulative voting may permit minority control of a board of directors.
- T F Preferred stockholders may foreclose if the corporation fails to pay them their annual dividends.
- T F The partner has less responsibility than the stockholder.
- T F Stockholders may normally claim dividends not declared by directors if the surplus is adequate.
- T F A stockholder is normally a creditor of the corporation.
- T F Bondholders are creditors; stockholders are not.
- T F Bondholders can foreclose; stockholders cannot.
- T F A bondholder may be the creditor of a company.
- T F A bondholder is necessarily part owner of a company.
- T F Stockholders may foreclose a mortgage if bond interest thereon is paid but common-stock dividends are not paid in any year.
- T F Common stockholders have voting privileges in more instances than preferred stockholders.
- T F With fixed capitalization and percentage of profit, the use of a bond issue in place of voting preferred stock provides at least two possible advantages to the common stockholder.
- T F Individual stockholders may be sued for the negligence of the officers of the corporation.

CHAPTER V

FUNCTIONS OF THE BOARD OF DIRECTORS

The real responsibility for carrying on the business of the corporation rests with the board of directors. The directors are the agents of the stockholders and are elected by the stockholders at the annual meeting. Their terms of office are usually of different lengths or, if of the same duration, only a portion of the board is elected each year so that the policies of the board may not be radically changed in any one year by the election of an entirely new board. The acts of the directors are not, however, subject to the approval of or to interference on the part of the stockholders. The only remedy for conduct unsatisfactory to the stockholders is the removal of such directors at the end of their terms of office. Vacancies in the board occurring between meetings are filled by the board itself.

The directors cannot act as individuals for the corporation as in the case of a partnership. Corporate action, in order to be binding, must be taken by the board of directors in a formal meeting and must result from a majority vote of the board. In special cases, one or more directors may be formally delegated by the board as a committee to attend to certain details or as an executive or finance committee to act in its place. In such cases the board is responsible for the action of the director or committee as its agent. Directors meet at regular intervals and at specially called meetings to transact the business of the corporation and to determine matters of policy.

The officers of the corporation, usually consisting of the president, one or more vice-presidents, secretary, and treasurer, are elected by the directors as prescribed by the bylaws. In most cases the president acts as chairman of the board of directors and presides at its meetings, but in some instances the board elects a chairman distinct from the president. The officers, particularly the president, are usually directors. This matter may be determined by bylaws where it is not specifically set forth in the

statutes. The compensation of officers is determined by the directors.

Practically all states provide for a minimum of three directors while some states name a definite maximum. In Indiana the maximum is twenty-one. In practically all cases the directors are required to be stockholders. Some states require that one or more directors shall be resident in the state of incorporation.

Although, as previously stated, a minimum of three directors may be required, it is sometimes possible to have almost a one-man corporation, approximating the business legally considered of a proprietorship or a partnership, by providing dummy directors. In past years there were many corporations in which the names of prominent men were used for directorates, with their consent, to establish the prestige of the business, these dummy directors devoting, however, practically no time to the business in question. If the control of the stock rests with one person or within a very small group, it is easily seen that a few shares of stock may be sold to individuals who are repeatedly reelected as dummy directors; thus the business, although organized in corporate form, is really a one-man corporation. Present tendencies, however, particularly in corporations of any considerable size, are toward the policy of electing directors who are expected to direct and who do direct corporate affairs.

The fact that all action, in order legally to represent the corporation, must be taken by the board of directors and not as an individual, renders the relations of directors to outside parties rather complex and at times embarrassing. The individual opinions and statements of directors, even when expressed in the best of faith, may be incorrectly interpreted by outsiders as representative of the policy of the corporation. Similarly, information coming from or extended to an individual director need not necessarily be considered as official, unless care is taken to see that it comes to the attention of the entire board and is formally acted upon by the board.

The directors are not individually held responsible to stockholders or to creditors for financial losses, if they exert ordinary diligence and prudence. If, however, it can be shown that they have been guilty of gross negligence, fraud, or exceeding their authority, they may not only be held financially responsible for such acts, but may be tried upon criminal charges as well. Under

the common law directors may be held liable for stock issued as fully paid, for which full value has not been received, or for the issuing of dividends from capital stock instead of taking them from net income or legitimate surplus.

The liability of directors for the payment of illegal dividends has been well stated as follows:

In most of the states a liability is imposed upon the directors by statute for any violation of the laws regulating dividends. In some cases offending directors are made liable for any and all debts of the corporation incurred during their term of office. In other cases they are liable only for the amount actually paid out in these illegal dividends. In some states they are not only held liable for the corporate debts, or for restitution in case of dividends illegally declared, but are also guilty of a misdemeanor punishable by fine and imprisonment.

If the directors of a corporation declare a dividend in violation of its charter or bylaw provisions, they may be enjoined from its payment, or, if not, would undoubtedly be held liable for any damage to the corporation which may result from the illegal dividend.

When dividends are declared which impair the capital stock or render the corporation insolvent, they not only subject the directors to liabilities and in some cases penalties, but such illegal dividends may be recovered from the stockholders to whom they were paid.

It is the well-determined doctrine of the courts of this country that the capital stock is a fund to be preserved for the benefit of corporate creditors. Hence the rule has been firmly established that, where dividends are paid in whole or in part out of the capital stock, corporate creditors being such when the dividend was declared or becoming such at any subsequent time, may to the extent of their claims, if such claims are not otherwise paid, compel the shareholders to whom the dividend has been paid to refund whatever portion of the dividend was taken out of the capital stock.^{1,2}

If a dividend has been paid out of the capital stock, the stockholders are conclusively presumed to have known it and are liable to an action for repayment. They cannot claim to hold the position of innocent or bona fide holders.

As already said, in some few states the officers are, together with the directors, liable for dividends paid in violation of statutory provisions. As a rule, however, the treasurer is not personally liable in any way for the payment of dividends ordered by the directors unless he knows such dividends to be absolutely fraudulent. In a few states, however, liability for dividends prohibited by statute has been extended by express enactment to the executive officers of the corporation if they consent

to concur therein. In such states, if the treasurer, knowing the dividends to be in violation of the statutory provision, nevertheless obeys the instructions of the directors and either pays such dividends or permits them to be paid, he is liable with the directors. There are, it may be said, but few states in which this liability exists.²

Directors, as individuals, may not use their knowledge of the internal affairs of the corporation to further their own personal ends to the detriment of the company. Those who are interested in or are officials of several corporations, some of which may be acting as vendor and others as purchaser in the same transaction, must take great care not to prejudice sale or purchase because of such private information. Difficulties of this nature led to legislative enactments opposed to so-called "interlocking directorates." Since such interrelations of legitimate business interests are likely to arise with large directorates, the available transactions are clearly defined in the bylaws of some corporations. For example, the following paragraph from the bylaws of a prominent corporation is self-explanatory:

Inasmuch as the directors of this company are men of large and diversified business interests, and are likely to be connected with other corporations with which from time to time this company must have business dealings, no contract or other transaction between this company and any other corporation shall be affected by the fact that directors of this company are interested in, or directors or officers of, such other corporation, if, at the meeting of the board, or of the committee of this company, making, authorizing, or confirming such contract or transaction, there shall be present a quorum of directors not so interested; and any director individually may be a party to, or may be interested in, any contract or transaction of this company, providing that such contract or transaction shall be approved or be ratified by the affirmative vote of at least ten directors not so interested.

Directors are usually not paid for their services. They may, however, vote as a board to pay salaries to the directors if this is done in advance of the service rendered and is not at variance with the bylaws. Such payment frequently takes the form of payment for each meeting attended. Unless this privilege is abused and abnormal salaries or meeting fees are paid, the action will not ordinarily be criticized by the stockholders. Sometimes the compensation is prescribed in the bylaws. Salaries voted to directors subsequent to the performance of the service may be

voided by stockholders' vote. If a director performs extra and special services for the corporation, outside of his normal duties as a member of the board, he may, of course, be tendered adequate additional renumeration. If, however, a corporation is insolvent or financially embarrassed, or if the net income or surplus is not adequate, requiring the payment of directors' compensation from capital, to the detriment of the stockholders, such amounts may be recovered in court.

The responsibility of the board of directors for the management of the corporation has already been noted. Much of the detailed work to this end is delegated to the officers of the company who are subordinate to the directors. There is, however, one very important duty which is invariably placed upon the board of directors, i.e., the declaration of dividends to the stockholders.

The decision of the board of directors is final with regard to the declaration of dividends. Generally speaking, no dividend can be paid, no matter how great the net profits may have been, unless formally declared by the directors. If the stockholders believe they are being wrongfully deprived of their just return and the directors decide not to pay a dividend, the stockholders' only recourse is the removal of one or more directors. In some corporations this can be done only at the end of a director's term of office. Stockholders have, from time to time, endeavored to force the payment of dividends through the courts in cases in which adequate profits have been known to exist, but such efforts have been generally unsuccessful. The stockholder may secure the aid of the courts, as previously pointed out, to prevent directors from voting themselves abnormal salaries or from otherwise fraudulently diverting the funds of the corporation into unworthy channels, but this power of the court does not extend to the granting of dividends or failure to do so upon the part of the directors. Although some corporations frequently have long, involved statements in their bylaws specifying the dates and conditions under which dividends are to be paid by the directors, the specifications most commonly found in bylaws that really conform to the common law upon the subject are worded substantially as follows:

"Dividends shall be declared only from the surplus profits at such times as the board shall direct, and no dividend shall be declared that will impair the capital of the company."¹⁸

Seldom will more definitive provisions be found in corporate bylaws. In the state of New Jersey, however, a rather unique and often unfortunate provision has been made, which compels directors of organizations incorporated within that state to pay dividends if there are any corporate profits, unless the charter or bylaws provide otherwise. This offers a good illustration of the necessity of studying the statutes of the state of proposed incorporation and of prescribing in the bylaws that the directors make reserves and provide working capital, which is ordinarily considered at least a conservative if not a necessary policy looking toward a successful financial structure for the corporation over a term of years.

The status of mandatory court decisions affecting the acts of directors of corporations as the result of lawsuits initiated by stockholders is well exemplified by the following quotations from typical decisions:

"The courts have, no doubt, in many cases overruled the directors who proposed to pay dividends, but I am not aware of any case in which the court has compelled them to pay when they have expressed their opinion that the state of the accounts did not admit of any such payment."⁴

The courts have, however, intervened in cases which may be illustrated by the following decisions:

"The directors must act in good faith. If they fail to do so and it clearly appears that they have accumulated earnings not required in the prosecution of the business which they withhold from the stockholders for illegitimate purposes, a court of equity may interfere and compel a distribution of such earnings."⁵

"Courts of equity will not interfere in the management of the directors unless it is clearly made to appear that they are guilty of fraud or misappropriation of the corporate funds or refuse to declare a dividend when the corporation has a surplus of net profits which it can, without detriment to its business, divide among its stockholders, and when a refusal to do so would amount to such an abuse of discretion as would constitute a fraud or breach of that good faith which they are bound to exercise toward the stockholders."⁶

A rather unusual reversal of the policy of directors by the courts is recorded in the following suit of a group of stockholders against the Ford Motor Company in the attempt to force the

directors to pay to the stockholders a portion of the large surplus that had been accumulated instead of turning it back into the business in order to carry out some of the altruistic plans of the founder of the corporation. The court said:

"It is not within the lawful powers of the board of directors to shape and conduct the affairs of the corporation for the mere incidental benefit of shareholders, and for the primary purpose of benefiting others, and no one will contend that, if the avowed purpose of the directors was to sacrifice the interests of shareholders, it would not be the duty of the courts to interfere."

It appeared that the company paid 60 per cent, or \$1,200,000, on its capitalization of \$2,000,000, leaving some \$58,000,000 to be reinvested. The decree of the court required the directors to declare an additional dividend of over \$19,000,000, which decree the highest court of Michigan unanimously affirmed.⁸

The question as to whether or not the directors, or only the stockholders, may have powers to amend or override the bylaws of the corporation is one of great importance if the policies of the corporation are to be conserved over a period of years, during which the personnel, and therefore the attitude of the board of directors, may change quite markedly.

In many states the statutes of the state permit the directors of a corporation to exert formidable powers over the corporate bylaws. In New Jersey, for example, the greatest freedom has been provided by charter to the effect that directors may actually override the bylaws that have been passed by the stockholders. Since the bylaws ordinarily provide the only real and direct controlling influence within the power of the stockholder over the policies of the corporation, with the exception, of course, of the election of the directors, if the latter may repeal or amend the bylaws at will, they are practically unrestrained, so long as they hold office, in their management and outline of policies of the corporation. Add to this the difficulty of removal of directors from office previous to the expiration of their term, except for illegal actions, and the transfer of such a wide range of authority from stockholders to directors may prove disastrous. Such statutes and charter provisions should, therefore, be carefully analyzed by prospective stockholders.

The personnel of the board of directors and therefore the continuity of its policies are dependent upon a fairly stable and

integral body of stockholders. Directors naturally place much confidence in the permanence and integrity of the majority of stockholders. It is to the advantage of the corporation and therefore to the stockholders who reap the advantages of successful management that no great amount of stock should change hands, or particularly that no controlling portion should fall into alien hands.

Specific References

1. Cook on Corporations, Par. 548.
2. CONYNGTON, THOMAS, R. J. BENNETT, and PAUL W. PINKERTON: "Corporation Procedure," p. 445, Ronald Press Company, New York.
3. CONYNGTON, THOMAS, R. J. BENNETT, and PAUL W. PINKERTON: "Corporation Procedure," p. 421, Ronald Press Company, New York.
4. *Bond Barow, etc., Co.*, p. 86, L.T. Rep. 10 (1902). (See also #3, p. 427.)
5. *Matter of Rogers*, 161 N.Y. 108 (1899); *Wilson Am. Ice Co.*, 206 Fed. 736 (1913); *Gehrt Collins Plow Co.*, 156 Ill. App. 98 (1910); *Spear R. R. Lime Co.*, 93 Atl. (Me.) 754 (1915). (See also #3, p. 427.)
6. *Hunter Roberts, Throp & Co.*, 83 Mich. 63 (1890). (See also #3, p. 427.)
7. *Dodge & Ford Motor Co.*, 204 Mich. 459 (1919). (See also #3, p. 427.)
8. See also #3, p. 428.

General References

- GERSTENBERG, CHARLES W.: "Financial Organization and Management of Business," Prentice-Hall, Inc., New York.
- IGNATIUS, MILTON B.: "The Financing of Public Service Corporations," Ronald Press Company, New York.
- MEAD, EDWARD SHERWOOD: "Corporation Finance," D. Appleton-Century Company, Inc., New York.

Review Questions

1. What are the qualifications specified for a director of a corporation in your home state?
2. What are the duties of a member of the board of directors?
3. Can a director act as an individual?
4. Can a director be held personally liable for his acts as a director?
5. How many of the officers of a corporation are also directors thereof?
6. Who determines the common-stock dividend policy and what recourse do the common stockholders have, if any?
7. Can the board of directors modify the bylaws?
8. Who pays the members of the board for their services?
9. What is the function of a dummy director?
10. Can the stockholders call a meeting of the board of directors?
11. Under what circumstances can stockholders force the directors to declare a dividend?

12. Are stockholders, other than members of the board of directors, liable for the negligence of the members of the board?

13. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

- T F Only the directors of a corporation may determine the amount of common-stock dividends to be paid.
- T F Dividends may be declared by the directors of a corporation from its surplus, if it has such, if the net income for the period is inadequate.
- T F The president of the corporation is always a member of the board.
- T F Only a quorum of the board is required to transact business officially.
- T F A contract by *A* in *A*'s name who is a member of the board of directors of B Company binds B Company.
- T F If *A*, a member of the board of B Company, is authorized by that board to represent them in negotiating with *C*, any legal contract entered into by *C* with *A* binds B Company.
- T F If the stockholders become dissatisfied with a director prior to the expiration of his term, they can force him to resign.
- T F Upon the death of a member of the board, the stockholders ordinarily elect a new member to serve out the deceased member's term.
- T F Notice given to an individual director is not necessarily binding upon the board as a whole.
- T F Directors may vote themselves a salary if not specifically prohibited by the bylaws.

CHAPTER VI

ORGANIZATION AND MANAGEMENT

The corporation is literally a "creature of the law." It has no existence, powers, privileges, or duties except as these are conferred upon it by statute. This artificial creature, known as the corporation, does not have, therefore, the rights of the individual to live and pursue whatever it pleases so long as the rights of others are not interferred with. Rather the corporation has only the artificial or legal rights dependent upon the constitution of the state of its birth, the legislative statutes, and the charter issued to it by the state.

For these reasons the incorporators, prospective stockholders, officers, and creditors of a corporation must study carefully these statutes and their relative merits in the various states of possible incorporation with special reference to the particular corporation in which they may be interested.

Unfortunately the requirements of the states vary widely with respect to many features of incorporation such as fees, taxes, restriction of "foreign corporations," acquiring and holding stock of other corporations, possibilities of no-par stock, cumulative voting, etc. In the early days of corporate organization, New Jersey offered particularly liberal inducements in its statutes and many of the large corporations were incorporated in that state, although they carried on much of their business in other states. Delaware and Maine now seem to have provided many of those corporate advantages and New Jersey is less liberal as the result of legislative enactments. It may be said, in general, that it is preferable to incorporate within the state where the home office of the corporation is to be established and where most of the incorporators reside unless there is some statute casting an especial burden upon a particular enterprise. Although the fees charged for incorporation and corporate taxes vary somewhat in different states, such advantages seldom outweigh the

lack of prestige often ascribed to the so-called "foreign corporations."

The term "foreign corporation" should not be confused with corporations of other countries than the United States. In the state in which the charter is granted a corporation is considered a "domestic corporation," while it is termed a "foreign corporation" in any other state.

The business of the foreign corporations is regulated to a greater extent than that of the domestic corporations in practically every state in the union. In some cases the duplicate of the corporate charter must be submitted, whereupon a license to transact business in the "foreign state" may be granted. In this license the legal agent of the corporation in the licensee state is specified. The maintenance of an office and legal agent within the state is the only requirement in some states, while in other localities the privilege of holding real estate is denied to such a corporation. Such restrictions apply only to corporations permanently established in the state in question and not to the soliciting of orders or the execution of contracts incidental to principal business functions.

Although the details of procedure necessary for the organization of a corporation vary materially, some principles may be outlined and a schedule of steps indicated for the general case.

A minimum of three original prospective incorporators, or interested parties, is necessary in practically all states. It is assumed, of course, that these incorporators have carefully considered the scope of the business they wish to undertake and possibly a suitable and comprehensive name for the prospective corporation. This matter is of more than casual importance. The corporation is a child of the state, born under legislative enactments and compelled by law to undertake certain activities outlined by its charter and only those. The possibilities of future expansion into new fields of endeavor should be seriously considered and a charter applied for which will be sufficiently broad and liberal not to prove a handicap at a later date.

The name to be adopted by the new corporation not only should be significant and comprehensive, but care must be taken not to duplicate or appear to duplicate that of other corporations, particularly competitors. Courts have ruled that an injunction may be authorized to restrain the new corporation from using a

corporate name similar to one previously adopted by another corporation, if such a duplication would create confusion in trade or interfere with the business of the original corporation.

These prospective incorporators should make, or cause to be made, a thorough investigation of the merits of such a corporation as they propose to organize. Too much emphasis cannot be placed upon the importance of such a complete analysis of the prospects of success for such a company. Many of the large number of corporate failures would be eliminated if proper attention were given to such a preliminary study.

"Problems in Business Finance"¹ may be quoted to advantage on this point as follows:

Most attempts to promote new enterprises "fizzle out." Yet in spite of this fact it appears to be fairly easy to raise enough money to launch any kind of a new concern—as evidenced by the Federal Trade Commission's report that probably half a billion dollars was recently sunk in worthless securities in the space of one year by the people of the United States. Even for those whose intentions are the best, it seems to be easier to raise capital to be thrown away than to decide whether there is any financial justification for launching the new concern. Unless there is some very special financial advantage connected with a new concern as compared with others in the same line of business, such as the ownership of a "100 per cent patent," which will confer a monopoly for a period of time, the occupation of a very superior location, the certain securing of lower operating expenses through improved methods of lower construction costs, or something of the sort, it is very doubtful whether there is in the long run any economic reason for launching a new enterprise, unless, of course, there should be a very rapidly growing and probably continuous demand for the commodity produced.

The mere fact that there is a "market" for the goods to be produced does not in itself decide that a given concern should be launched. There may be others, more effective, coming into the field. Even granting that all conditions are favorable, the stage of the business cycle may be wrong for the starting of the new enterprise, on account of the high absolute costs and a possibility of a depression in the near future.

For launching a concern in order to develop an absolutely new idea, after the *other* logical requirements are met, the chief question is that of *demand for the commodity* to be produced or the *service to be rendered*. Many a financial miscarriage has resulted from the failure to realize that, no matter how admirable the idea or how secure the patent rights, and the like, the public may have no use for the new commodity. . . .

Assuming honest intentions throughout, it may be stated with regard to the problem of securing capital to launch a new, small concern—and all successful concerns have small beginnings—that the original financing should be done largely in a private manner. Ownership and responsibility for the outcome should go hand in hand. Ordinarily outsiders should not be expected to risk their money, unless the proposition is understood by them to be a speculative one, until the business has demonstrated its capacity to earn a return on the initial investment.

Although such an examination will vary greatly in content and method of analysis with the nature of the business contemplated, a few suggestions will be offered to indicate the general trend of the inquiry:

1. Present, past, and future demand for the product to be manufactured or sold.
2. Permanency and possible fluctuations of such a demand.
3. Nature and magnitude of present and possible future competition.
4. Likelihood of introduction of new products as improvements or substitutes.
5. Success and growth of competitive corporations.
6. Cost of manufacture, maintenance, and improvements.
7. Estimated cost of plant.
8. Capital required to start and develop business.
9. Tendency of legislation relating to this business.
10. Control by government, if any exists.
11. Status of labor problem in this particular industry.
12. Attitude of municipality toward new enterprise.
13. Possible locations available should be investigated with respect to:
 - a. Raw materials and supplies.
 - b. Market for finished product.
 - c. Building facilities for plant and housing of employees.
 - d. Renting facilities for plant and employees.
 - e. Labor supply.
 - f. Railroad facilities.
 - g. Availability and cost of power, fuel, light, heat, water, and insurance.
 - h. Insurance and safety requirements.
 - i. Employer's liability and compensation acts.

- j. Climate and effect of seasons upon business, sales, and manufacturing processes.
 - k. Possibility of expansion.
 - l. Conveniences for doing business.
 - m. Opportunities for recreations and likelihood of contentment among employees.
14. Detailed estimate covering prospects of profits and their increase in the future.

In the case of a small merchandising corporation the answers to many of the above problems will be self-evident, particularly to those having had some experience in the same or a similar line of business in the past. It is well, however, in all cases, to inquire about or at least devote some thought to each of the above items in all cases.

In large public utility, mining, engineering, building, or manufacturing corporations, it is customary to employ experts to make such preliminary investigations of an unbiased character and to submit a complete and detailed report thereon. The tendency of prospective incorporators to paint the possibilities of success in too rosy a tint is conservatively checked by such a procedure and the expense of such an investigation is, in most cases, not only wise but actually necessary.

Unfortunately lack of such investigations has frequently created disfavor in the public mind because of the exaggerated statements often attributed to the "promoter." There are promoters and promoters.

A promoter is a person who brings about the incorporation and organization of a corporation. He brings together the persons who become interested in the enterprise, aids in procuring subscriptions, and sets in motion the machinery which leads to the formation of the corporation itself. . . .

A person who procures subscriptions and aids in organizing the company and frames the papers and manages the procuring of options and the vesting of title is a promoter, even though he is also a subscriber.²

The general doctrine that no one is authorized to contract for a corporation before it is formed applies to all contracts with and by promoters. The promoter is himself liable on these pre-corporate contracts, unless otherwise expressly provided, but the corporation is not.³

Some promoters are justly criticized by the conservative investor or prospective incorporator but such criticism should not prejudice one against an unbiased authentic study of conditions precedent to incorporation.

All business enterprises owe their existence, in the beginning, to the imagination of some one man. Very frequently he cooperates with others, so that the original plans appear to be the results of the joint efforts of a group of men. The American Telephone and Telegraph Company owes its existence to the imagination of Alexander Graham Bell and his enthusiastic confidence in the commercial adaptability of the telephone, but the success of the company in its earliest years was due quite as much to the financial skill of another man, the advertising ability of still another, and the power of organization of yet another. In one sense, Bell was the promoter of the telephone company because he conceived the instrument and foresaw its economic significance. But in another sense, his associates are all to be looked upon as promoters because their united efforts were required to launch the new undertaking.⁴

The engineering student, anticipating a business career based upon his engineering training as a foundation, very naturally adapts himself to the present-day methods of engineering analysis of industry both prior to as well as subsequent to incorporation. The professional promoter, having given way to a large extent to the lawyer and banker, now sees the latter basing their legal and financial surveys and recommendations upon the reports of the engineering investigator; or the engineering firm cooperates with the lawyer and banker as modern promoters. Such comparatively recent opportunities for the engineer are well stated in the following pertinent quotation from the Alexander Hamilton Institute.⁵

Engineering firms as promoters: The fourth class—and this is a recent important development—consists of engineering firms engaged in construction work of various kinds. Certain large engineering concerns have established a wide reputation for success in operating street railroads, water works, electric lighting plants, and so on. These firms naturally have built up a large and well-equipped staff of experts in those fields. As the staff is expensive, it becomes a pressing problem to keep them profitably employed all the time. In the effort to solve this problem such firms have drifted into the custom of taking up new enterprises of merit and performing the work of promotion themselves.

Their prime object in so doing is to employ their own engineering talents and the abilities of their staff to the best advantage. Incidentally, of course, they have no objection to securing some of the other returns that naturally follow from successful promotion.

These engineering promoters have three great advantages which have told heavily in their favor:

1. They are able to carry on a thorough investigation of any project that is presented to them without much extra expense; and, as they are constantly engaged in such investigations, they have developed a body of experts who are able to give the best possible judgment as to the outlook for success in each instance. Consequently, they seldom go wrong.

2. They are almost invariably big enough and have resources enough to finance the projects which they undertake themselves, if necessary. However, as they are primarily engineers, not financiers, they nearly always prefer to secure the greater part of the funds from other persons. This they accomplish by calling to their assistance some large banking and brokerage house, which will undertake to sell the securities of the corporations organized by the engineering firms. The alliance thus formed is of great advantage to the banking house, inasmuch as it may accept with confidence the results of the investigation carried on by the engineering firm's experts.

3. The engineering firm, having a reputation to acquire and sustain, does not desert the new enterprise as soon as financed, as most promoters do, but sticks with it until it is a thoroughly established success. The engineering firm must have on its staff experts, not only in planning and building the street railroad or power plant or whatever the new project may be, but also in operating the enterprise. It is in position, therefore, not merely to put the new corporation on its feet, but to give it a running start toward success. Furthermore, if the corporation later gets into difficulties, the engineering firm may be relied upon to come to its assistance.

The engineering student will recognize at once the familiar analyses suggested in the fourteen items listed, not excepting No. 8, which may be repeated for the sake of emphasis as "Capital required to start and develop the business." The former value, and in some states the latter value, must be stipulated in the application for a charter for the proposed corporation. The forms of stocks and bonds to be issued in order to raise this capital must also be decided upon. The many considerations involved in these decisions are set forth in Chap. XII. Some states place statutory limitations upon minimum capital to be authorized,

that with which to begin business, and upon the maximum and minimum possible par values of stock.

With these vital decisions completed with respect to the new corporation, an application for a charter may be made to the Secretary of State or to the Commissioner of Corporations of the state selected for incorporation. Most states furnish application blanks, which must be made out in duplicate and which set forth all the data required by the state regarding the proposed enterprise. Such requirements in Indiana will be noted as follows:

3. Incorporators and Purposes for Which Corporations May Be Formed under the General Corporation Act.⁴—Except as hereinafter provided, any lawful business which may be conducted by an individual may be conducted by a corporation organized under this act (4824).

No corporation shall engage in the conducting of more than one kind of business and its allied and interdependent lines of business (4829).

4. Incorporation Procedure.—The successive steps to be taken in the formation of corporations are:

Preparation, execution, and acknowledgment of certificate of incorporation in duplicate (see No. 5 below).

Submission of articles to the Secretary of State (see No. 5 below).

Issuance by Secretary of State of certificate of incorporation if approved by him (see No. 5 below).

Filing of duplicate original articles of association in the office of the recorder of the county in which the principal place of business is to be located (see No. 5 below).

5. Articles of Incorporation.—Whenever three or more persons shall desire to form a corporation, they shall prepare, sign, and acknowledge in duplicate before a notary public and file with the Secretary of State articles of incorporation which shall set forth:

- a. The names and addresses of the incorporators.
- b. The name of the proposed corporation, which in every case shall end with the word "company," "corporation," or "incorporated," which name shall not be the same as, or strikingly similar to, that of any existing corporation.
- c. The business to be done by the corporation.
- d. The amount of the capital stock of the corporation, the number and size of the shares thereof, and the price per share at which the stock is to be or shall have been sold.
- e. The county in which the principal office or place of business of the corporation is to be located, with its post-office address.

f. The business or property, if any, which is to be taken over by the corporation and the value thereof, including the good will, stating the value of the tangible property and the value of the good will separately.

g. The number of directors of the corporation, not less than three, and the names of those who are to manage its affairs until its first annual meeting.

h. The length of life of the corporation, not exceeding fifty years.

i. The time and place of the first annual meeting.

j. A description of the seal of the corporation (4825).

Filing and Approval of Articles of Incorporation. Appeal.—Such articles of incorporation shall be submitted to the Secretary of State, and if he shall approve the same, he shall issue his certificate certifying that the corporation, naming it, is authorized to transact the business named in the articles of incorporation. If such Secretary of State shall not approve such articles, he shall, within ten days after the filing of the same, notify the parties interested, specifying the particulars of his disapproval, and the parties seeking to incorporate may appeal to the circuit or superior court of the county of the proposed domicile of the proposed corporation by filing certified copies of all proceedings, except evidence, whereupon the matter shall be tried *de novo* by the court without the intervention of a jury, and from the decision of the court there shall be an appeal to the Supreme Court. Said court shall sustain the Secretary of State or shall direct him to take such action as the court may deem adequate and proper (4826).

Filing with County Recorder.—Whenever the articles of incorporation of any corporation have been approved by the Secretary of State, a duplicate thereof, approved by the Secretary of State, shall be filed with the county recorder and by him recorded in the miscellaneous records of the county (4827).

In some states a certain percentage of the total capital stock must be paid in before the charter can be granted. This provision often complicates the process of incorporation. It involves either the relatively large purchase of stock by the interested incorporators or a campaign for the sale of stock before the corporation whose stock is being offered for sale really exists. In states where a corporation commission exists, this commission may carry on the preliminary negotiations until the charter has been granted. The first meeting, however, should formally approve the preliminary activities of trustees or commission and make such approval a matter of record.

When the application has been filed in a form satisfactory to the state and all conditions pertaining thereto have been com-

pleted, including the payment of the necessary incorporation fees, a charter is issued. This charter bears the state seal and the signature of the prescribed state official, thus formally establishing the corporation. The form of this document, designated as a "certificate of incorporation," in the state of Massachusetts is as follows (other types will be found in Appendix A):

COMMONWEALTH OF MASSACHUSETTS⁷

Be it known that, whereas [the names of the subscribers to the agreement of association] have associated themselves with the intention of forming a corporation under the name of [the name of the corporation], for the purpose [the purpose declared in the agreement of association], with a capital stock of [the amount fixed in the agreement of association with a statement of the several classes into which the stock is divided and their respective amounts, and of the method of paying for such stock, whether by cash in full, cash in instalments, property, services, or expenses, or partly by one method and partly by another or others], and have complied with the provisions of the statutes of this commonwealth in such case made and provided, as appears from the articles of the organization of said corporation, duly approved by the commissioner of corporations and taxation and recorded in this office: now, therefore, I [the name of the secretary], secretary of the commonwealth of Massachusetts, do hereby certify that said [the names of the subscribers to the agreement of association], their associates, and successors are legally organized and established as, and are hereby made, an existing corporation under the name of [name of the corporation], with the powers, rights, and privileges, and subject to the limitations, duties, and restrictions, which by law appertain thereto.

Witness my official signature hereunto subscribed, and the great seal of the commonwealth of Massachusetts hereunto affixed, this _____ day of _____ in the year ____ (the date of filing of the articles of organization).

The state secretary shall sign the certificate of incorporation and cause the great seal of the commonwealth to be thereto affixed, and such certificate shall have the force and effect of a special charter. . . . (G. L., c. 156.) . . .

11. *Amendment of Articles of Incorporation.*—Every corporation may, at a meeting duly called for the purpose, by the vote of a majority of all its stock, or, if two or more classes of stock have been issued, of a majority of each class outstanding and entitled to vote, authorize an increase or a reduction of its capital stock and determine the terms and manner of the disposition of such increased stock, or authorize such terms and manner of disposition to be determined in whole or in part by the board of directors or officers of the corporation, may authorize a change of the location of its principal office or place of business in this commonwealth or a change of the part value of the shares of its capital stock, or may authorize proceedings for its dissolution under Sec. 50 of Chap. 145 (see No. 48 below). Such increased stock may in whole or in part be disposed of without being offered to the stockholders. Any corporation having authorized shares with par

value may, at a meeting duly called for the purpose, by the vote of a majority of all its stock, or, if two or more classes of stock have been issued, of a majority of each class outstanding and entitled to vote, including in any event a majority of the outstanding stock of each class affected, change such shares or any class thereof into an equal or greater number of shares without par value, or provide for the exchange thereof pro rata for an equal or greater number of shares without par value; *provided*, that the preferences, voting powers, restrictions, and qualifications of the outstanding shares so changed or exchanged shall not be otherwise impaired or diminished without the consent of the holders thereof. (G. L., c. 156, 41.)

Every corporation may, at a meeting duly called for the purpose, by vote of two-thirds of each class of stock outstanding and entitled to vote, or by a larger vote if the agreement of association or act of incorporation so requires, change its corporate name, the nature of its business, the classes of its capital stock subsequently to be issued, and their preferences and voting power, or make any other lawful amendment or alteration in its agreement of association or articles of organization, or in the corresponding provisions of its act of incorporation, or authorize the sale, lease, or exchange of all its property and assets, including its good will, upon such terms and conditions as it deems expedient. (G. L., c. 156, 42.)

Within thirty days after any meeting at which any amendment or alteration of the agreement of association or articles of organization has been adopted, articles of amendment, signed and sworn to by the president, treasurer, and a majority of the directors, setting forth such amendment or alteration and the due adoption thereof, shall be submitted to the commissioner, who shall examine them with the same powers as in the case of the original articles of organization, and, if he finds that they conform to the requirements of law, shall so certify and endorse his approval thereon. Thereupon the articles of amendment shall, upon payment of the fee provided in Sec. 54 (No. 22 below) or 55 (No. 6 above), as the case may be, be filed in the office of the state secretary, who shall cause them and the endorsement thereon to be recorded. No such amendment or alteration shall take effect until such articles of amendment shall have been filed as aforesaid. (G. L., c. 156, 43.)

A stockholder in any corporation which shall have duly voted to sell, lease, or exchange all its property and assets or to change the nature of its business in accordance with Sec. 42, who, at the meeting of stockholders, has voted against such action may, within thirty days after the date of said meeting, make a written demand upon the corporation for payment for his stock. If the corporation and the stockholder cannot agree upon the value of the stock at the date of such sale, lease, exchange, or change, such value shall be ascertained by three disinterested persons, one of whom shall be named by the stockholder, another by the corporation, and the third by the two thus chosen. The finding of the appraisers shall be final, and, if their award is not paid by the corporation within thirty days after it is made, it may be recovered in contract by the stockholder from the corporation. Upon payment by the corporation to the stockholder of the agreed or awarded price of his stock, the stockholder shall forthwith transfer and

assign the stock certificate held by him at, and in accordance with, the request of the corporation. (G. L., c. 156, 46.)

Such a charter must be recorded by the recorder of deeds of the county in which the corporation establishes its home office. Failure thus to record the charter has been known to be regarded by the courts as a failure to incorporate and the supposed incorporators of such an organization not formally established have been found personally liable, as in the case of a partnership, to the creditors of the organization that was supposed to be a corporation.

The charter having been granted and registered, and the incorporation thereby completed, the stock and bond sale must be inaugurated or completed, as the case may be. In the small so-called "closed corporation" in which all the stock is held by a few stockholders, this process is accomplished very quickly and easily. The money that has been set aside for this project is at once available for capitalization of the enterprise. In the larger projects, or those of a more speculative character, some campaign of publicity must be carried on to interest outside capital.

A prospectus is prepared, often in very elaborate and exaggerated style, setting forth the nature of the new corporation and its prospects for success. This is given a wide circulation among prospective purchasers and advertisements are run in the technical and daily publications.

Stock-subscription lists are prepared in several forms for different classes of subscribers and stocks and bonds are subscribed as a result of personal solicitation.

In the more pretentious campaigns a promoter is employed to manage this portion of the problem of placing the new corporation upon its feet. This is an art in itself. It becomes particularly necessary in large public utility, mining, and new manufacturing projects where capital must be assembled from many small and widely separated investors who are unacquainted with the product. Such projects are often promoted by large engineering corporations employing a large staff of expert engineers, accountants, and financiers who have been trained for the necessary appraisals, investigations, and promotion campaigns. Although the sale of stock by employees and customers of well-established corporations, and particularly of the public utility corporations, has taken on tremendous proportions during the last decade, as

described in Chap. IV, such opportunities are necessarily closed to the prospective corporation before organization.

The problem of stock and bond sale is a more complex one when much of this work must be done previous to incorporation, thereby affording no opportunity for a definite contract with the promoter. In such cases, and there are many, particularly in the speculative class, the promoter must assume great responsibilities himself. He may make his own investigation or employ experts to do it. Upon satisfying himself that a good opportunity for promotion exists, he acquires the necessary options, for which he may have to make a considerable investment. Where options are not available or practicable, the rights, patents, or property in question may have to be purchased by him outright. In short, the promoter combines valuable privileges, rights, and options in such a way as to make an attractive business proposition. He then points out the possibilities thereof to many investors and sells the former to the latter with a profit to himself. Such a profit he often takes in the form of a certain number of shares of stock in the corporation itself as later organized. Thus it develops that stock watering is often necessary in order to promote a new enterprise, the future of which is open to question. The property, rights, and services of the promoter are often acquired by the corporation at inflated values, thus depreciating the true value of the stock issued in return.

Prior to the organization of the corporation, the ordinary subscription is merely a continuing proposition from the subscriber to the proposed corporation for the purchase of a specified amount of stock. At this stage the subscription is not a complete enforceable contract, because the other party thereto—the proposed corporation—has no legal existence, and, until the corporation is formed, the death, insanity, or voluntary withdrawal of the subscriber would cancel the proposition and thereby terminate the proposed contract."⁸

After the corporation is organized and, by either expressed or implied acceptance of the subscriptions to its stock, has completed its part of the contract, the subscription list becomes a binding agreement between the parties thereto, and its specific enforcement becomes possible.⁹

The acceptance of a valid subscription by the corporation not only renders the contract a binding one but also, of itself, constitutes the subscriber a stockholder of the corporation. If his subscription is made

to a trustee for the corporation, he becomes a stockholder as soon as the corporation is organized and his subscription is turned in by the trustee. In either case nothing further is necessary to establish him legally in his position nor in the enjoyment of his rights as a stockholder. The delivery of the stock certificates, while a formal recognition of this status, confers nothing that he did not have before, being simply a convenient evidence of his stock interest. . . .

Even though the subscriber never pays his subscription, he is a stockholder from the time of his acceptance of his subscription until such time as by proper procedure his subscription is cancelled or forfeited for noncompliance with its conditions.¹⁰

"The subscription to stock must be distinguished from an agreement to purchase stock."¹¹ "In the first instance the subscriber becomes a stockholder immediately upon the acceptance of his subscription by the corporation. In the latter case he does not become a stockholder until the consummation of his agreement and the delivery to him of his certificates of stock. A subscription list might be so worded as to be merely an agreement to purchase stock, in which case the subscribers would not be stockholders until they received their certificates of stock."¹²

It is to be noted that under the common law, unless otherwise specified in the agreement of subscription, the entire capital stock of the proposed corporation must be subscribed before any of the subscriptions are binding and enforceable.¹³

In some of the states this has been modified by statute, but unless this has been done the rule prevails, and where it is desirable that subscriptions for a less amount than the entire capital stock shall hold, the subscription list should so specify. Any person competent to contract may make a binding subscription for stock. A subscriber for stock need not necessarily be an incorporator of the company, though usually, as a matter of statutory requirement, an incorporator must be a subscriber to the company's stock. One corporation cannot usually subscribe for the stock of another corporation, though it may be permissible in the case of a corporation authorized to hold the stock of other corporations.¹⁴

When the organization of a corporation is contemplated, not infrequently a trustee, or trustees, will be selected to act for the inchoate corporation. Some arrangement of the kind is necessary where subscriptions to the stock of the corporation are to be made binding before

its organization. Also it is usually advisable to have definite parties in charge of the matter who have power to act for the subscribers.

Such trustees frequently collect payments on subscriptions, make disbursements in the interest of the new enterprise, and in some cases actually carry on the undertaking until such time as the corporation may be advantageously organized and put in control of the going concern.

No matter how far such trustees may have carried the corporate affairs nor to what extent they may have contracted in the interests of the corporation, they have the same individual liability on these contracts and the same inability to force them on the corporation, as in the case of any other precorporate contracts.¹⁵

Effect of Failure to Incorporate.—When contracts are entered into in expectation of the formation of a corporation and on its behalf, the trustee's status, if the corporation fails of incorporation, depends upon the nature and condition of the contract. A subscription to its stock, no matter how irrevocable, would be terminated; if payments had been made thereon to a trustee, any unexpended amount might be reclaimed; and if the trustee were to blame for the failure to incorporate, he might be responsible for the portion expended as well. Other contracts, if clearly made on behalf of the proposed corporation, would in most cases be terminated. If not clearly so made, the parties acting for the corporation might be held to specific performance, or for damages for nonperformance. If the contracts were made with the distinct understanding that they were for the benefit of the proposed corporation, the parties acting for the unorganized corporation could not insist on performance for their own benefit.

Subscribers may under some circumstances be held liable as partners for expenses incurred if the attempted incorporation is not effected. Thus where a projected incorporation failed the court said: "Under the facts disclosed in this case, the corporation had no existence; there was simply an immatured intention of the parties to form a corporation. . . . There being no responsible principal, the associated parties must be held liable as partners." In Illinois, Mississippi, and some other states the statutes provide that the incorporator shall be held personally liable where the incorporation is incomplete.¹¹

Assuming that the capital has been secured from investors who, upon issue of their stock certificates, have become stockholders of the new corporation, these stockholders hold their initial meeting, elect directors, and take steps toward the adoption of bylaws. The activities and responsibilities of the directors have already been outlined.

The bylaws are the internal laws and rules of the corporation. Great care should be exercised in their preparation. They may not, of course, run counter in any detail to the federal Constitution, public policy as defined by the courts, the statutes of the state, or the charter of the corporation; they may not be inequitable, unjust, or unreasonable; but beyond these limitations the stockholders are all-powerful in stipulating rules of corporate procedure. In order that the statutes and the corporate charter may not be violated inadvertently, they are often made a matter of record in the minute book of the board of directors. The bylaws are, of course, always thus recorded.

Although the content and exact wording of the bylaws will vary widely with the type of corporation and the state in which incorporation takes place, the forms outlined in Appendix A, will indicate the important considerations for such a document.

After the stockholders have approved the bylaws, the directors are elected in accordance therewith. The directors then meet, approve the bylaws, elect the officers of the company, and plan the organization and policies of the business. The business then proceeds under the "law of contracts," the latter being entered into by the directors.¹⁶

When a corporation has been created by the state, it comes into being free, unencumbered, with no existing business relations, and with no debts, contracts, or obligations of any kind, save those expressed in its charter and in the statute law of the state of domicile. It is not bound by anything done or said before its incorporation unless embodied in its charter. A corporation cannot be bound before it exists, as no one could then act with authority as its agent or representative.¹⁷

After its organization, the corporation may recognize or accept any proffered contracts it sees fit, and this applies to contracts made on its account before its incorporation. Its acceptance of such a contract may be expressed or implied. If the corporation takes the benefit of the contract, it is liable thereon without any express recognition or formal acceptance.¹⁸

A well-planned business is carried on by a very carefully selected staff of heads of departments. These heads of departments are usually employed by the officers of the company in accordance with a systematic organization chart which sets forth

the responsibilities of each group of employees and their relation to both superiors and subordinates.

Andrew Carnegie valued his organization more highly than either capital or plants. He knew that with a good organization and his reputation as a successful operator he could secure capital at a moment's notice, while the building of a successful organization required years of careful effort.

The successful organizer is a master of the art of human relations. The proof of this is that there are certain super-personalities who have developed that most perfect team play while violating every law of the science of organization. This does not prove that these men might not have accomplished more if they had known more about the laws which some centuries of experience have proved were most successful in the majority of cases; it merely goes to show that an organization can be operated by a genius.

Perhaps the most notorious example of this is found in one of our latest and most successful industries, whose cash balances are the envy of all competitors, which exists without a title—outside of a few required by law—in the whole organization. In this case any man can have any other man's job if he can demonstrate he can fill it better than the existing incumbent. Some departments have as many as three heads at one time—all engaged in proving which shall survive as the fittest. The pace is terrific and the fear and hatred engendered is poisonous, but so far the country has supplied enough able men who were willing to endure the conditions for the sake of the large salaries.

Another almost equally successful industry of the first magnitude is a hotbed of favoritism. The owner selects and keeps the men he likes—regardless of their efficiency. Pull is more important than ability. Justice is supplanted by favor and mercy, but the boss is such a benevolent despot, and withal so shrewd and foresighted on the commercial and economic side, that his competitors have every few years alternately predicted his ruin with smug satisfaction and then gathered at his feet in devout admiration to learn how he got away with it.¹⁹

Between these two extremes lie the great majority of industrial businesses which must necessarily set up some form of organization plan and approximate such a theoretically scientific ideal as closely as the exigencies of the business and the limitations of available personnel will permit. One of the best definitions of a successful organization which may be quoted in one sentence—a sentence full of opportunity for careful study is as follows: "Practical industrial organization is a matter of fitting the existing or obtainable personnel to the physical layout best fitted

to the conduct of the business, in such a way as to attain the maximum continuous return on the investment with the least friction."

One or more of the three following basic principles is involved in every organization:

1. Line organization.
2. Staff organization.
3. Functional organization.

Line Organization.—The first and perhaps the most natural form, commonly known as the "military or line organization," follows the essential features of the earlier types of the organized armies of the world. As the term "line" implies, every man in such an organization is directly responsible to one particular individual immediately above him in rank and to him only. Instructions are passed down in a definite sequence from manager to employee through definite prescribed channels as from captain in the army to private. As the analogy to the military regime is all too frequently applied, it should be noted that the line organization is more correctly associated with the ancient inflexible military rule than with the organization of the modern army division. In the latter are to be found various types of subordinate units, each trained for a special service. For the direct purpose of control they are all under the immediate orders of the division commander; for the specialized activities, however, each unit looks to its chief of service at general headquarters. Such a logical military plan, which is similar to the organization of a large railway system, more nearly exemplifies the modern staff and line administration of large industrial establishments.

In contrast with this, there formerly existed in the pure line organization the situation in which every employee acted entirely independently of others upon the same level elsewhere in the organization. The nature of the work to be accomplished and the relative mental responsibility and physical labor allocated to each foreman were approximately the same for all foremen of the same authority level.

The accompanying chart, Fig. 8, is typical of the principle of line organization although its applications and the designation of each position may vary widely in different corporations. Rigid disciplinary control, such as is practiced in the army, is not only possible but necessary in such an organization. Every officer

and employee knows his exact status, duty, and responsibility and no misunderstandings should result. Figure 9* shows a more detailed application to a power plant.

With the present-day tendency toward democratization, not only of industry but of civilization in general, and with the trend away from the arbitrary dictatorship of the early proprietor or domineering partnership toward the widely flung negotiations of managers and directorates of the modern large corporation, the decline of the line organization is apparent.

Some serious business defects are found to exist in such a system. Executives and executive activities become diversified

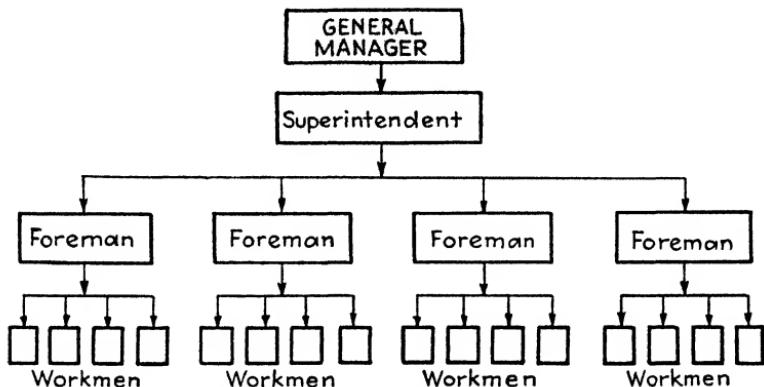


FIG. 8.—Typical line organization.

and individuals in otherwise equally authoritative levels are loaded up with many varied duties requiring cooperative relations rather than a strict sequence of disciplinary orders. Instructions become less positive and often inadequate. More and more initiative and diplomacy are required of all the individual foremen. The loss or absence of one foreman link in the chain of sequential orders may unfortunately delay the progress of the business as a whole. Such a system, based principally upon a line organization, is therefore practically obsolete except possibly in the very small and simple forms of business carried on by a very conservative and long-established personnel.

Staff and Line Control.—Secondly, the staff organization, or, better, a combined line and staff organization such as that graphically represented in Fig. 10,* groups together under the direction

* KIMBALL, DEXTER S., "Industrial Economics," McGraw-Hill Book Company, Inc., New York, 1929.

of the general manager the treasurer, accountant, factory manager, and sales manager, each of comparable authority but each in direct charge of entirely different functions of the business. Frequently such a form of organization involves several vice-presidents, all reporting to the president and through him to the board of directors, although each is a specialist in charge of his own particular department of the business.

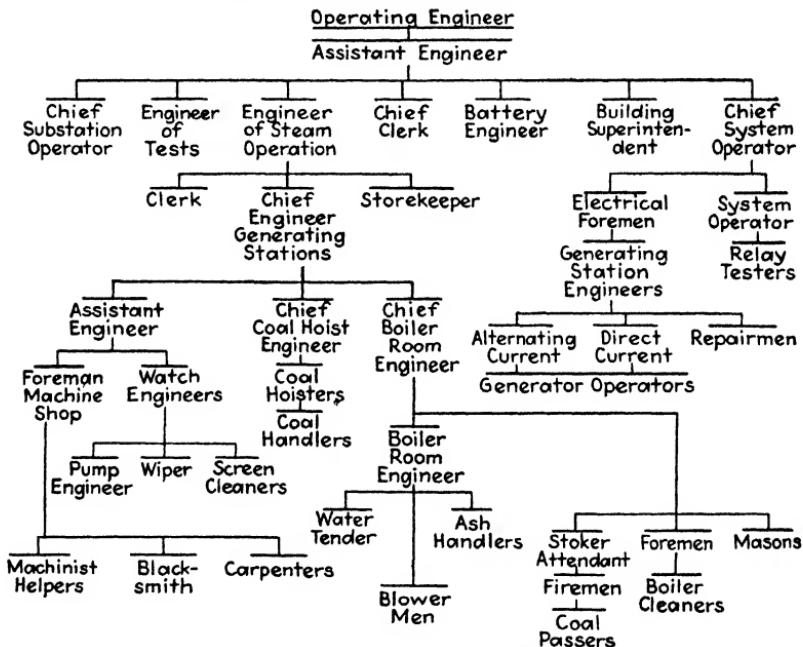


FIG. 9.—Expanded line organization.

Under the factory manager will be found grouped his staff officers, such as the purchasing agent, chief engineer, factory superintendent, welfare and cost departments, etc. The factory superintendent, in turn, may have a staff consisting of those in charge of the tool room, orders, stores, inspection and employment departments, etc. Thus specialists, capable of giving expert advice upon the many diversified functions of the business, are retained in their most effective capacities and yet the strong disciplinary advantages of line control between the subordinate groups need not be sacrificed if due care is exercised in acquainting each department head with his range of action and responsibility to his superior.

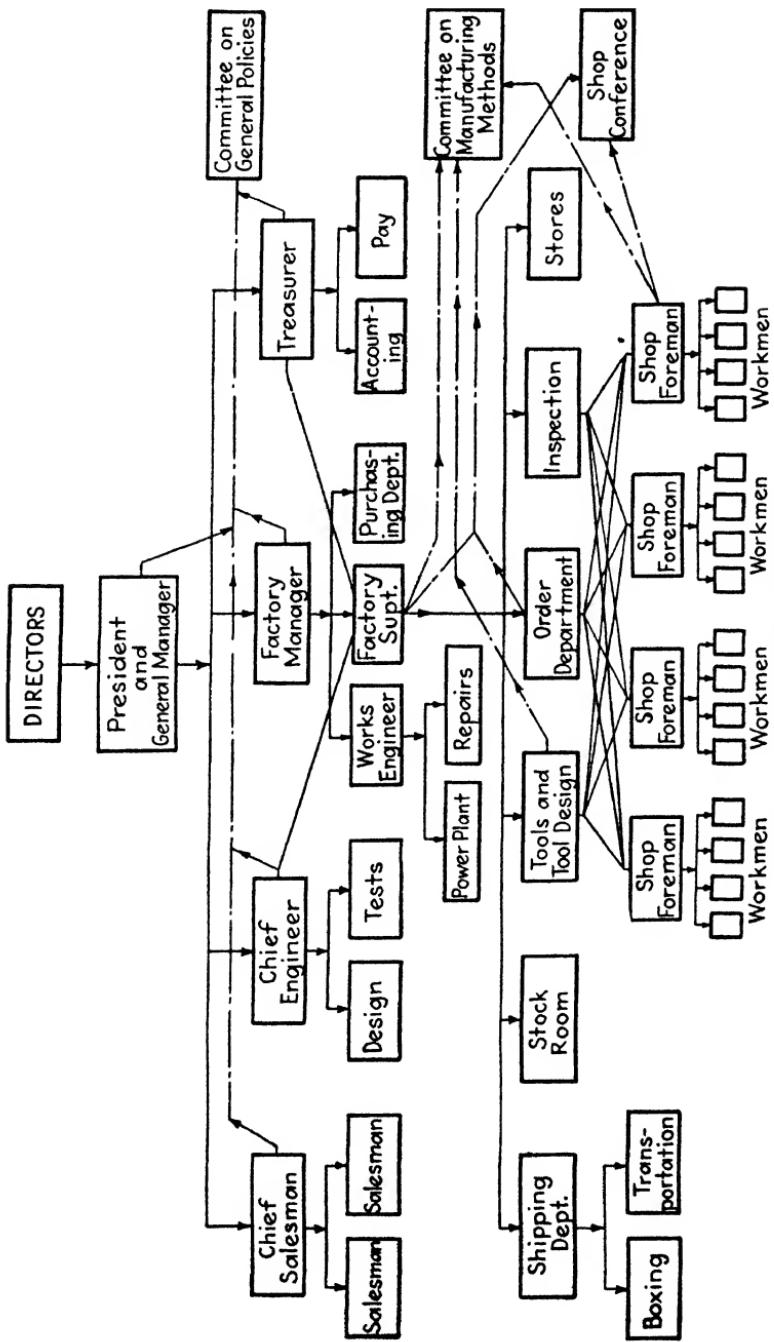


Fig. 10.—Line and staff organization.

Functional Control.—The staff organization carried to extremes becomes a functional control. The dependency of one department or official upon another is practically eliminated and the subdivision of activity and responsibility is in accordance with the function of the business to be performed thereby. Each employee receives advice and directions from many so-called foremen, each of whom is a specialist in his particular field. Thus the various graduations of skilled or unskilled labor are segregated

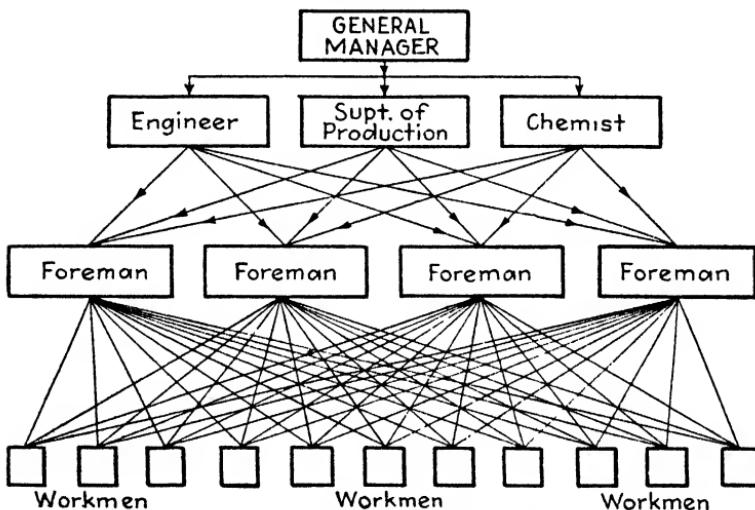


FIG. 11.—Functional organization.

and the mental and purely physical processes are separated one from the other and independently directed and inspected.

Figure 11* illustrates the interrelations of such a system which necessarily make possible more opportunities for misunderstandings and disagreements as to authority, with resultant weakening of disciplinary control. If used or approximated, such an organization must have established strong coordinating agencies such as frequent conferences, the delegation of policies to committees, etc., which will keep the heads of departments informed, thereby avoiding divergent methods and unnecessary delay or lack of adjustment of output.

The form the coordinating influence takes is not so important as the fact that it does exist. If we consider, for example, another common form of functional organization, such as indicated in

* *Ibid.*, p. 209.

Fig. 12,* it will be noted that each of the three vice-presidents in charge of sales, production, and finances, respectively, represents a distinct element that exists in most corporations. These may be considered of equal importance to the success of the business but they can function only as they take into consideration the functions and operations of each other. Such coordinating influences have been likened by one organization expert to the governor of an engine in that they prevent well-intentioned but overzealous executives from "running away with themselves."

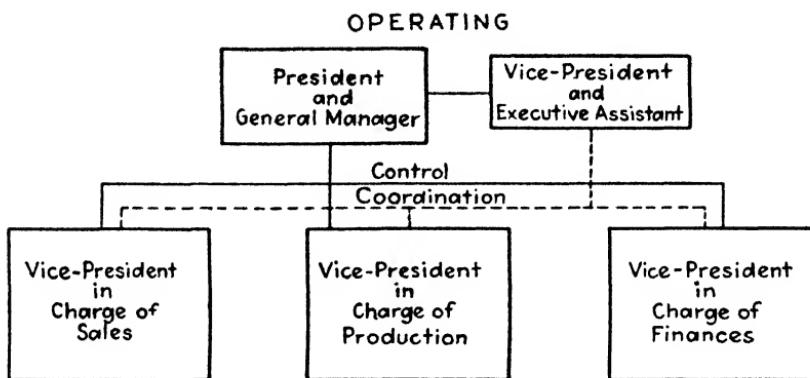


FIG. 12.—Functional organization showing coordinating influence.

A system of committees, sometimes adopted for such coordination of interests, has the following advantages, according to Theodore Williams, general manager of Economy Baler Co.²⁰

1. It keeps the executives of the line organization on their toes in fulfilling the duties of their respective positions because all troubles or interferences in progress come to the attention of some committee, and this eliminates the great game of "passing the buck."
2. It creates clearer understanding between members and builds up the *esprit de corps*.
3. It saves time for the executives higher up, as only the important items that the committees have not authority to solve are brought to their attention.
4. It gives the executive committee, which is the supreme power, complete control of all important matters that these subordinate committees solve, as the minutes and reports of these subcommittee meetings are read before the executive committee at its weekly meetings.

* *Administration*, August, 1921.

5. It presents to the management an opportunity to unearth first-class men from its rank and file, since the ability of each member is displayed in the minutes of each meeting.

6. It is human nature to procrastinate, but, with a combination of organized committees and clearly defined executive duties, one is in competition with the other to prevent putting off necessary acts or falling into error.

Although the tendency to decentralize and democratize industry is certainly on the increase, the extensive use of committees outlined by Mr. Williams is not frequently found.

However, daily or at least weekly group conferences of divisional heads in cooperation with the general manager or shop superintendent are generally recognized as a necessary coordinating factor in functional organizations.

Such policy-defining conferences, formed for the purpose of coordinating the work of various departments, should not be confused with the so-called "shop committees," made up of representatives of officials and employees for the study of personnel and labor problems. These will be discussed more in detail later.

Successful organizations of today, whether they are manufacturing, merchandizing, or public utility corporations, are principally the outgrowth of small private business of several decades ago. Since each important line of business worthy of study has had its own history and traditional development, which have molded its present managerial structure and personnel, it is not practical, or indeed possible, to establish a diagrammatic chart that may be considered ideal for a particular company. Such diagrams are of value only as skeleton outlines of comparison. They frequently tend toward a solution too theoretical or academic for practical use.

On the other hand, the organization chart cannot be neglected as a guide and basis for comparison of responsibilities in the formation of and the efficient operation of the successful corporation. Mr. Glenn G. Munn, assistant manager of the Personnel Department of the Chase National Bank of New York City, has the following to say in support of such an organization chart:

The formation for playing the business game is shown on the organization chart. Such a chart pictorially represents the duties and responsibilities assigned to each employee. The relations of employees are shown by the relative position of each rectangle on the chart. The

lines of authority are indicated from the president down to the rank and file. To play the game successfully the formation must be understood. Each member of the team must know the part he is expected to play, the corresponding responsibilities of this part and from whom to take his signals or orders. Failure to understand lines of authority and responsibility is answerable for much of the friction and wasted effort always present where there is a lack of team work in a complex organization. . . . A canvass of the personnel . . . merely shows what employees in the organization are doing. Investigation and study are then required to find out if the work individual employees are doing is necessary, or all they can do, or more than they should be expected to do, or done in such a way as to make control easy, or fix responsibility when mistakes are made.

Where responsibility cannot be fixed, inefficiency is sure to creep in.

If the business has been allowed to grow without the charting of its course, the preparation of the chart showing the organization as it exists is likely to reveal many defects and much "out-of-jointedness." Most growing enterprises expand when and where they will, as needs dictate. Hence in an organization of any size *a chart is required* to show clearly the functions that are duplicated or unnecessary or becoming obsolete; or the duties that are handled by the wrong employee; or the departments that are under- or overmanned or under- or oversupervised; or the individuals upon whom more responsibility might with advantage be placed.

While an organization chart cannot minutely describe every duty and function, it can at least show who is responsible for the execution of work in any division, department, section, or unit of the business. It can show whether the duties are coordinate or subordinate and indicate their relative importance. It can definitely connect certain individuals with specific functions and duties. Where functions overlap and lines of authority run in two directions, it is not easy to limit and fix them unless a chart is drawn up *showing the ideal organization as it should be.*

By means of a chart it is possible not only to divide the activities of an organization into divisions, departments, sections, and units but to analyze further a unit of work into particular jobs, and to determine the qualities that are necessary for their performance. . . .

The chart will also show the progression or sequence of jobs, that is, where a particular job naturally leads to. This is again helpful to the personnel department in pointing out the natural line of promotion. It is also important in the reassigning of men to different jobs when it becomes apparent that they are not succeeding in the job to which they were originally assigned.

By showing coordinate and subordinate functions and by distinguishing between employees who are organizers, supervisors, and detail men, the chart is a means of determining the relative importance of jobs and

therefore their relative value to the business. The determination of salaries is, of course, a matter based on the value of man's services. . . .

Another practical use to which the organization chart can be put is in the transfer of employees from one department to another. The personnel officer should have a chart large enough to visualize the complete organization, showing the names of the officers and listing the employees in the department to which they belong. The names of the officers and employees should be inserted in their proper places in such a way that changes can be readily made. . . .

Such a chart is a running inventory of the personnel—both quantitatively and qualitatively. It is consulted when vacancies are to be filled and employees promoted, or when temporary pressure in one department requires the transfer of employees of a certain type from other departments. Given such a chart, transfers can be intelligently made by any executive.

The problems of organization of personnel are well outlined in the form of general rules by Lieutenant-Colonel W. C. Jacobs in the following quotation:²¹

1. Determine what the purpose is for which the organization has been formed.
2. Provide a final authority at all points where decisions must be rendered and subsequent action taken.
3. Carefully and completely define the authority and responsibility of each position.
4. Assign personnel to positions according to their prospective or demonstrated capacity.
5. Avoid dual subordination. This is a vitally important rule.
6. Combine disciplinary authority with responsibility.
7. Equalize the burdens of administration.
8. Have no positions from which the outlook on promotion is limited.
9. Provide for flexibility so that any situation may be adequately coped with.

In many organization charts which are presented as being representative of those actually in use, or recommended for use, it may be noted that various personnel are indicated as being responsible to two or more superiors. Fundamentally, this conception is quite wrong because a division of responsibility and any uncertainty as to where this responsibility lies will always be conducive to doubt and confusion. In connection with responsibility and authority there is also the element of discipline and if personnel is subject to more than one source of authority it is also subject to more than one source of discipline and this fact will inevitably produce inharmonious relations.

On the other hand, dual responsibility, the reverse of dual subordination, is quite possible and very frequently a highly desirable situation in any organization. The line and staff type of organization adapts itself perfectly to dual responsibility when there is any need therefor. For example, referring to Fig. 13,* we see that the general manager is the head of the operating element. In addition, it would be perfectly possible for him to act as sales manager. In this case we would have

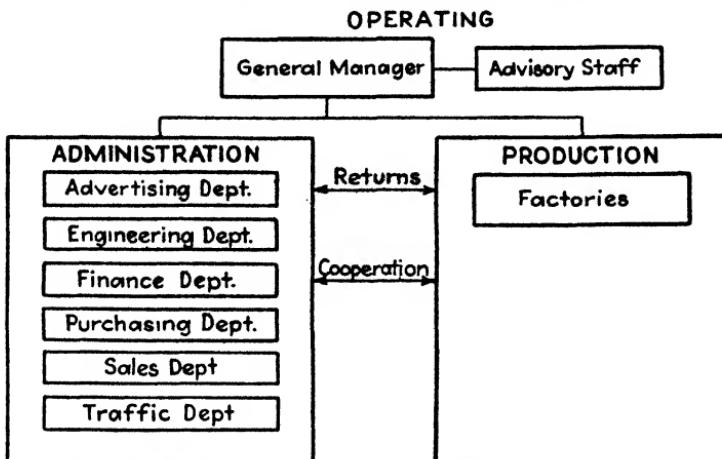


FIG. 13.—Line and staff organization showing possibility of dual responsibility. the general manager acting in a dual capacity without in any way violating the principles on which the organization is based or changing the chart representing this organization. This idea of dual responsibility is frequently a very necessary one in all organizations, particularly in those where the expansion is rapid. In such cases the growth of the organization will often outstrip the acquisition of reliable personnel, and those capable of doing so will necessarily be called upon to fill more than one position. In so doing, they simply fit into the plan of organization as conceived and work as harmoniously in two or more positions as they would in one.

Although the same principle of line, line and staff, or functional organization underlies practically all well-conceived successful corporations, whether they are governmental, manufacturing, merchandizing, construction, public utilities, or holding companies, some special features and local modifications will be found in each group which are peculiar to the type of business that is being undertaken. Only a few such may be suggested by way of illustration:

* *Administration*, August, 1921.

The United States government has long understood the value of a line and staff organization, although its application may have been largely blundered due to political mismanagement. Each of the Cabinet officers is a line official having under him many thousands of subordinates. When the Cabinet officers assemble at the call of the President, they become the President's staff, advising him on questions of policy and so on. In the Cabinet they have no executive authority but receive directions from the President who, presumably, will largely formulate his decisions as the result of these staff conferences. The decisions will then be put into effect by the same Cabinet officers acting in their line capacity and charged with executing the directions of the President. The need of the third element (the coordinating influence) has recently become apparent to the administration in Washington. This is evident by the . . . appointment of the Executive Secretary to the President who has an ex officio position in the Cabinet and who is charged with coordinating the efforts of the various governmental departments headed by the present Cabinet officers. The creation of this position gives evidence of the fact that the line activities of the government have had a tendency to forget their interdependence, there having been an inclination for each one to develop according to its own ideas and to assume functions and responsibilities which in many cases properly belonged to other departments or were duplicated by them.²²

Although not necessarily replacing the organization chart in the case of the public utility, a classified list of officers will frequently be found. Such a list is the accompanying group of official personnel of one of the largest electric light and power corporations of this country as described in its annual report to its stockholders.

DIRECTORS AND OFFICERS

At the Annual Meeting of Stockholders held the Board of Directors was increased from nine to thirteen members.

[Thirteen names listed]

EXECUTIVE COMMITTEE

[Seven names listed, all of whom are directors]

FINANCE COMMITTEE

[Six names listed, all of whom are directors]

OFFICERS

Chairman.

Vice-chairman.

President.
Four Vice-presidents.
Secretary and Assistant Treasurer.
Treasurer and Assistant Secretary.
Auditor.
Three Assistant Secretaries.
Three Assistant Treasurers.
Three Assistant Auditors.
Assistant to Chairman.

ORGANIZATION

Chairman.
Vice-chairman.
President.
Vice-president (in charge of operating, construction, and electrical departments).
Vice-president (in charge of purchasing, stores, transportation, and statistical departments).
Vice-president (in charge of auditing and customers' accounts departments).
Vice-president (in charge of sales of electric light and power).
Manager of Industrial Relations and Chairman Public Relations Committee.
Assistant to Chairman (in charge of publicity and advertising).

OPERATING, CONSTRUCTION, AND ELECTRICAL DEPARTMENTS

Two Assistants to Vice-presidents.
Chief Operating Engineer.
Assistant to Chief Operating Engineer.
Superintendent of Generating Stations.
Superintendent of Street Department.
Assistant Superintendent of Street Department.
Superintendent of Substations.
Superintendent of Meter Department.
Chief Load Dispatcher.
Superintendent of Service and Repair Department.
Superintendent of Underground Cables.
Superintendent of Conduit Construction.
Superintendent of Overhead Lines.
Electrical Engineer.
Construction Engineer.
Chief Testing Engineer.
Engineer of Inside Plant.
Engineer of Distribution.
Assistant Construction Engineer.
Budget Director.
Construction Engineer, Electrical Division.
Construction Engineer, Structural Division.
Construction Engineer, Mechanical Division.
Machinery Inspector.

132 BUSINESS ADMINISTRATION FOR ENGINEERS

Superintendent of Telephone Service.

Superintendent of Buildings.

Assistant Superintendent of Buildings.

PURCHASING, STORES, TRANSPORTATION, AND STATISTICAL DEPARTMENTS

Assistant to Vice-president.

Engineering Assistant to Vice-president.

Statistician.

Purchasing Agent.

General Storekeeper.

General Manager of Electric Shops.

Fuel Agent.

Superintendent of Bureau of Merchandising Cooperation.

Superintendent of Transportation.

General Merchandise Salesman.

Superintendent of Transportation.

Superintendent of Mails and Information.

AUDITING AND CUSTOMERS' ACCOUNTS DEPARTMENTS

Auditor.

Three Assistant Auditors.

Disbursement Clerk.

Engineer, Cost Accountant.

Superintendent of Customers' Accounts Department.

Assistant Superintendent of Customers' Accounts Department.

FINANCES, SECURITIES, CLAIMS, SECRETARY AND TREASURER

Secretary and Assistant Treasurer.

Treasurer and Assistant Secretary.

Three Assistant Secretaries.

Three Assistant Treasurers.

Cashier.

Credit Officer.

Chief Clerk, Mercantile Bookkeeping Department.

General Supervisor of Collections.

Paymaster.

General Timekeeper.

Superintendent of Accident Liability Department.

Superintendent of Bill Adjustment Department.

Correspondence Advisor.

SALES OF ELECTRIC LIGHT AND POWER

Power Engineer.

Head Lighting Agent.

Superintendent of Application Bureau.

Superintendent of Advertising Department.

INDUSTRIAL AND PUBLIC RELATIONS

Assistant Manager of Industrial Relations.

Dean of Women.

Superintendent of Employees Service Division.

Director of Public Relations.

Chief Surgeon.

Superintendent of Safety Division.

Thus, in the case of a large electric light and power company, as well as in the companies directed in the past by Andrew Carnegie, George Westinghouse, Theodore Vail, and other captains of industry, organization is frequently built around an individual. Except in the case of such masters of executive ability, however, there often lurks a danger in such a policy. Such a difficulty frequently exists where corporations have developed rapidly from small beginnings. Unfortunately, such a development leads to an illogical plan of organization and interferes with the proper training and encouragement of subordinates who must necessarily prepare for more responsibility in the organization at a later date.

Walker has stated that

It is an axiom of administration that no single individual should become indispensable in an organization. Every plan should be thought out with care, keeping this idea in view along with the principle of developing responsibility in a line of subordinates. Consistent policies in promotions are necessary adjuncts to the last-mentioned phase. Nothing is more detrimental to morale than to have a vacancy at the head of one department filled by the process of extending the duties of the head of some other department so that the latter person takes over the work. It is a blow to departmental pride that more than offsets any likely saving in salary, providing the original plan was well developed at the start. It suggests favoritism and breeds suspicion. . . . It has been said that any company desiring to establish cooperative relationships with labor can do so if the desire is sincere. The personal characteristics of the administrative head will be manifested, not alone as to this matter of attitude toward labor but in many other ways as well.²²

Chart of the Holding Company.—The holding company, that new entrant into the public utility field, has its own peculiar problems of organization. Although discussed from another angle in Chap. VIII, its chart peculiarities may be touched upon to advantage here.

These may be depicted best by the reproduction of a unique holding-company organization chart, Fig. 14, and its explanation, quoted from the description of the Western Massachusetts Companies in *Electrical World*:

Early in 1927 a number of closely affiliated gas and electric utilities serving the Connecticut Valley and other parts of western Massa-

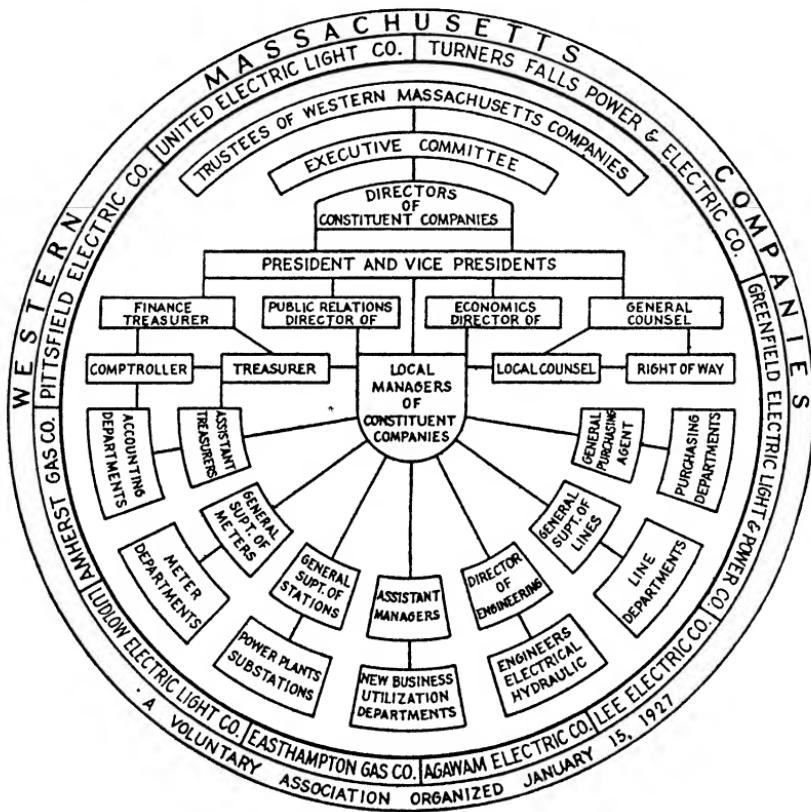


FIG. 14.—Holding-company organization.

chusetts organized a voluntary association designated as the Western Massachusetts Companies. These now include the Turners Falls Power & Electric Company, United Electric Light Company (Springfield), Greenfield Electric Light & Power Company, Pittsfield Electric Company, Amherst Gas Company, Ludlow Electric Light Company, Easthampton Gas Company, Agawam Electric Company, and Lee Electric Company. The operation of these properties, with combined assets over \$36,000,000, has been centralized and coordinated along

the lines illustrated in the accompanying chart, the general policy being to maintain the individuality of local administration hitherto enjoyed by these constituents, along with their pooled financial, equipment, operating, executive, and other resources.

The chart is practically self-explanatory. The trustees administer the association on behalf of the stockholders of the constituent companies, the immediate conduct of affairs being in the hands of an executive committee working in harmony with the directors of the local properties and through the president and vice-presidents of the holding organization. The administration of each constituent property centers in its local or resident manager, through whom contact is made with the headquarters staff officers and executives of the association. General jurisdiction over local company departments is exercised by specialist executives available to local managers on the one hand and over local departments on the other. The treasurers and comptrollers contact through the local managers with the subsidiary properties and also by direct line with the accounting departments of the constituent companies. The director of economics and engineering exercises the functions of a technical consultant for the association and its properties besides having executive charge of all electrical and hydraulic engineering activities, with specialist executives reporting to him. These examples and examination of the chart will show that an unusually flexible and compact organization has been set up to allow the utmost freedom of cooperation between the officers and specialists of the association and of the constituent utility companies.

The chart is functional in its arrangement, and in some cases the same individual fills an office in a constituent company that he occupies in the association. Thus, the director of engineering indicated on the chart for each local company holds this post in the association general staff. The size and make-up of the local staff depend on the conditions in each local company.²⁴

Construction companies have still another problem of organization. Since construction programs call for the completion of the inherent parts upon a definite schedule, the personnel must frequently be transferred from one subordinate position to another or the organization must be expanded or contracted to meet the exigencies of irregular construction demands. These conditions in turn depend upon the condition as to whether the contract is a lump sum, cost plus percentage, or cost plus fixed sum.*

* See HARDING and CANFIELD, "Legal and Ethical Phases of Engineering," McGraw-Hill Book Company, Inc., New York.

The Pyramids of the Cheops were built with 100,000 men during a continuous period of from fifteen to twenty years. There was extreme hardship, loss of life, and absolute disregard for human effort. Under modern methods such pyramids could be built in one-half the time and with one-half the number of men then required. This would be accomplished by what the contractor calls "plant."²⁵

The organization chart might look quite like that of Fig. 15.*

The operating organization of a large light and power company may have its own local detailed plan of organization such as is indicated in Fig. 9, which is self-explanatory for the student of engineering.

Lastly the organization chart may be used to portray at a glance the method of attack upon a new problem, as, for example, the development of electric service for the farm, which has been so vigorously undertaken by public utilities and engineering schools during the last few years. Such a chart as shown in Fig. 16,²⁶ which has been prepared by Professor Frank D. Paine of Iowa State College, Ames, Iowa, may be analyzed to advantage and used as a basis for other similar studies.

Whatever the organization chart of officials may be on the one hand and the subdivision of responsibilities of employees on the other, the connecting link or coordinating element between the two must be given serious attention. Upon such relations between capital and labor, volumes have been written and hundreds of cooperative plans have been tried; business has succeeded as the result of the humane, diplomatic, and ethical solution, or failed as a result of the dictatorial, brow-beating, driving methods now fortunately in the minority. It is not within the scope of this volume to discuss this question at length, but, since the coordinating committee relations necessary between officials have been explained and since the so-called shop committees, previously mentioned, will receive analysis later, this treatise would fall far short of its ideal if it did not portray that document drawn up for such a purpose by the National Industrial Conference, convened in Washington upon the call of the late President Woodrow Wilson on Dec. 1, 1919, which reconvened in January, 1920, and produced the report from which the following pertinent portions are quoted.

* *Administration*, August, 1921.

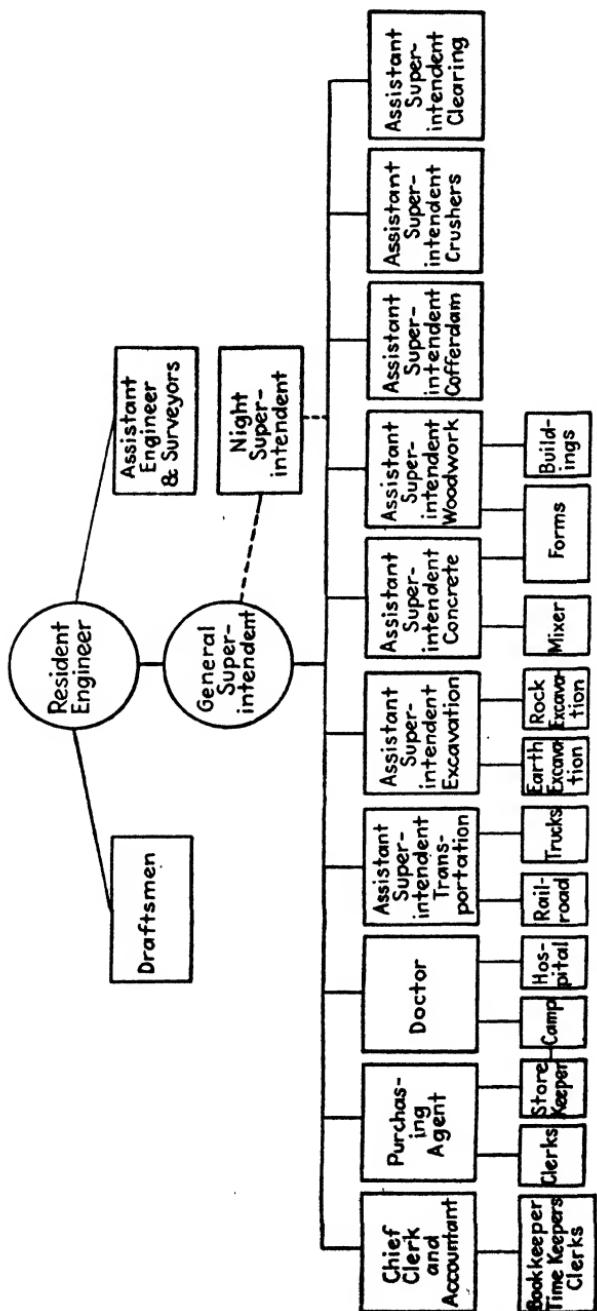


FIG. 15.—Organization chart of a construction company.

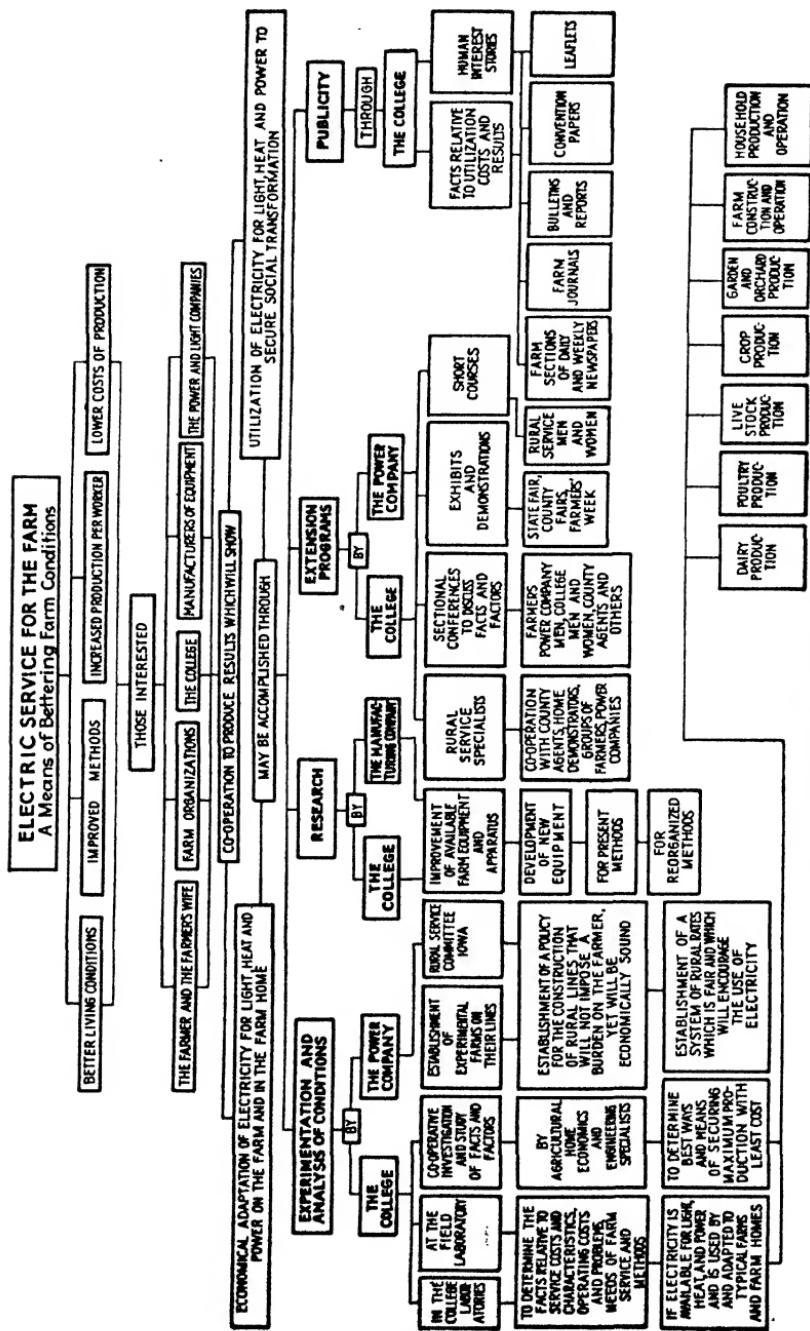


Fig. 16.—Organisation chart for electric service for the farm.

The causes of industrial unrest are many. Among others they include the rise in the cost of living, unrestrained speculation, spectacular instances of excessive profits, excessive accumulation and misuse of wealth, inequality in readjustments of wage scales, release of ideas and emotions by the war, social revolutionary theories imported from Europe, the belief that free speech is restricted, the intermittency of employment, fear of unemployment, excessive hours of work in certain industries, lack of adequate housing, unnecessarily high infant mortality in industrial centers, loss of personal contact in large industrial units, and the culmination of a growing belief on the part of both employers and employees that a readjustment is necessary to a wholesome continuity of their united effort.

For the most part causes of unrest are not the result of the war; they have been accentuated by it. Much investigation and public discussion have been devoted to these matters. The relative importance and emphasis laid on the different causes varies with each investigator. The conference, in Part IV, has made suggestions for dealing with some of the conditions enumerated, and it hopes that progress toward remedying them may be accelerated by the further development of employee representation and by the use of the suggested machinery for adjustment.

There is, however, a feature of the present industrial unrest which differentiates it from that commonly existing before the war. It cannot be denied that unrest today is characterized more than ever before by purposes and desires which go beyond the mere demand for higher wages and shorter hours. Aspirations inherent in this form of restlessness are to a greater extent psychological and intangible. They are not for that reason any less significant. They reveal a desire on the part of workers to exert a larger and more organic influence upon the processes of industrial life. This impulse is not to be discouraged but made helpful and cooperative. With comprehending and sympathetic appreciation, it can be converted into a force working for a better spirit and understanding between capital and labor, and for more effective cooperation.

The wisest suggestions for the prevention and relief of industrial unrest are to be found by interpreting the best thought and experience of those employers and employees who, within the area of their own activities, have most successfully dealt with the problem. The conference in making its final report has considered the interpreting of actual achievements its most useful function. It believes that practical experience is more useful than the views of extremists on either side. Such experience shows that no group of men can successfully undertake to deal with the interests of other groups without their cooperative participation in the methods of equitable adjustment.

The guiding thought of the conference has been that the right relationship between employer and employee can be best promoted by the deliberate organization of that relationship. That organization should begin within the plant itself. Its object should be to organize unity of interest and thus to diminish the area of conflict, and supply by organized cooperation between employers and employees the advantages of that human relationship that existed between them when industries were smaller. Such organization should provide for the joint action of managers and employees in dealing with their common interests. It should emphasize the *responsibility of managers to know men at least as intimately as they know materials*, and the right and duty of employees to have a knowledge of the industry, its processes, and policies. Employees need to understand their relation to the joint endeavor so that they may once more have a creative interest in their work.

Industrial problems vary not only with each industry but in each establishment. Therefore, the strategic place to begin battle with misunderstanding is within the industrial plant itself. Primarily the settlement must come from the bottom, not from the top.

The conference finds that joint organization of management and employees where undertaken with sincerity and good will has a record of success. The general principles governing such organization are stated at length under the title, "Employee Representation." It is not a field for legislation, because the form which employee representation should take may vary in every plant. The conference, therefore, does not direct this recommendation to legislators but to managers and employees.

If the joint organization of management and employees in the plant or industry fails to reach a collective agreement, or if, without such joint organization, disputes arise which are not settled by existing agencies, then the conference proposes a system of settlement close at hand and under government encouragement, and a minimum of regulation. The entrance of the government into these problems should be to stimulate further cooperation.

The system of settlement consists of a plan, nation wide in scope, with a National Industrial Board, local Regional Conferences, and Boards of Inquiry, as follows:

1. The parties to the dispute may voluntarily submit their differences for settlement to a board, known as a Regional Adjustment Conference. This board consists of four representatives selected by the parties, and four others in their industry chosen by them and familiar with their problems. The board is presided over by a trained government official, the regional chairman, who acts as a conciliator. If a unanimous agreement is reached, it results in a collective bargain having the same effect as if reached by a joint organization in the shop.

2. If the Regional Conference fails to agree unanimously, the matter, with certain restrictions, goes, under the agreement of submission, to the National Industrial Board, unless the parties prefer the decision of an umpire selected by them.

3. The voluntary submission to a Regional Adjustment Conference carries with it an agreement by both parties that there shall be no interference with production pending the processes of adjustment.

4. If the parties, or either of them, refuse voluntarily to submit the dispute to the processes of the plan of adjustment, a Regional Board of Inquiry is formed by the regional chairman, of two employers and two employees from the industry, and not parties to the dispute. This board has the right, under proper safeguards, to subpoena witnesses and records and the duty to publish its findings as a guide to public opinion. Either of the parties at conflict may join the board of inquiry on giving an understanding that, so far as its side is concerned, it will agree to submit its contention to a Regional Adjustment Conference, and, if both join, a Regional Adjustment Conference is automatically created.

5. The National Industrial Board in Washington has general oversight of the plan.

6. The plan is applicable also to public utilities, but in such cases the government agency, having power to regulate the service, has two representatives in the Adjustment Conference. Provision is made for prompt report of its findings to the rate regulating body.

The conference makes no recommendation of a plan to cover steam railroads and other carriers, for which legislation has recently been enacted by Congress.

7. The plan provides machinery for prompt and fair adjustment of wages and working conditions of government employees. It is especially necessary for this class of employees, who should not be permitted to strike.

8. The plan involves no penalties other than those imposed by public opinion. It does not impose compulsory arbitration. It does not deny the right to strike. It does not submit to arbitration the policy of the "closed" or "open" shop.

The plan is national in scope and operation, yet it is decentralized. It is different from anything in operation elsewhere. It is based upon American experience and is designed to meet American conditions. It employs no legal authority except the right of inquiry. Its basic idea is stimulation to settlement of differences by the parties in conflict, and the enlistment of public opinion toward enforcing that method of settlement.

PREVENTION OF DISPUTES

Joint Organization through Employee Representation

Prevention of disputes is worth more than cure. The conference feels that a new basis of industrial peace may be found in the further development of the democratic organization of the relations of employers and employees, now widely in progress through the country.

Modern industry, as conducted in large plants, has caused a loss of personal contact between employers and employees. It has also caused, through high specialization and repetitive mechanical processes, a loss of creative interest. But it makes possible a greater production of the material things which contribute to the common resources of the people. Upon these resources an advancing civilization, with a higher common standard of living, must depend.

Direct personal contact in the old manner cannot be restored. It is necessary, therefore, to find the best possible substitute through democratic representation. Employees need an established channel of expression and an opportunity for responsible consultation on matters which affect them in their relations with their employers and their work. There must be diffused among them a better knowledge of the industry as a whole and of their own relation to its success. Employee representation will not only enable them better to advance their own interests, but will make them more definitely conscious of their own contribution, and their own responsibilities.

Employee representation has been discussed under different names and forms, such as shop committees, shop councils, works councils, representative government in industry, and others. But representation is a definite principle rather than a form. The conference, therefore, prefers the generic term "employee representation." In using this term the conference has in mind the successful application of the principle to various activities outside, as well as within, the purely industrial field.

From both employers and employees the conference has received thoughtful and helpful suggestions as to the possibilities, under proper conditions, of employee representation. These suggestions clearly proceed from a genuine desire that this movement may spread in accordance with sound principles and be kept from perversions which would threaten its lasting usefulness by making it an agency of attack rather than a means to peace.

Employee representation organizes the relations of employer and employee so that they regularly come together to deal with their common interests. It is operating successfully under union agreements in organized shops. It is operating in nonunion shops, and it is operating

in shops where union and nonunion men work side by side. In plants working under union agreement, it adds to collective bargaining an agency of cooperation within the plant. It is itself an agency of collective bargaining and cooperation where union agreements do not obtain.

It is idle wholly to deny the existence of conflicting interests between employers and employees. But there are wide areas of activity in which their interests coincide. It is the part of statesmanship to organize identity of interest where it exists in order to reduce the area of conflict. The representative principle is needed to make effective the employee's interest in production, as well as in wages and working conditions. It is likewise needed to make more effective the employer's interest in the human element of industry.

The idea of employee representation has aroused opposition from two sources. On the one hand, in plants too large for direct personal contact, employers who still adhere to the theory that labor is a commodity hold off from any form of cooperation with employees. This view is steadily disappearing and will, it is hoped, wholly disappear. On the other hand, a number of trade-union leaders regard shop representation as a subtle weapon directed against the union. This thought is apparently based on the fear that it may be used by some employers to undermine the unions. Conceived in that spirit no plan can be a lasting agency of industrial peace.

But occasional misuse of employee representation and the consequent hesitancy of organized labor to endorse it officially are based on a misconception of the possible and desirable relations between the union and the shop committee. This relation is a complementary, and not a mutually exclusive, one. In many plants the trade union and the shop committee are both functioning harmoniously. In some establishments the men are unionized, and the shop committees are composed of union men. In others, some men belong to the trade union while all belong to the shop organization.

The union has had its greatest success in dealing with basic working conditions, and with the general level of wages in organized and partially organized industries and crafts. It has also indirectly exerted an influence on standards in unorganized trades. There is no reason to suppose that in the future this influence will not continue.

Local problems, however, fall naturally within the province of shop committees. No organization covering the whole trade, and unfamiliar with special local conditions and the questions that come up from day to day, is by itself in a position to deal with these questions adequately, or to enlist the cooperation of employer and employee in methods to improve production and to reduce strain. Except for trades in which the union itself has operated under a system of employee representation, as it does in shipbuilding and in the manufacture of clothing and in other

trades, these internal factors are likely either to be neglected or to be dealt with in a way which does not make for satisfactory cooperation.

The existence of employee representation in plants operating under union agreement does not necessarily reduce the scope of the union representative's work. But matters are more likely to come to him as questions of the application of an agreement rather than as mere grievances. In other words, he has greater opportunity for service in negotiation of an essentially conciliatory nature. The fortunate results of such development have been evident in industries in which employee representation and trade unions have for some time been functioning harmoniously.

Employee representation must not be considered solely as a device for settling grievances. It can find success only if it also embodies cooperation in the problem of production. Whatever subjects the representatives come to feel as having a relation to their work, and their effectiveness as members of the plant, may come within the field of committee consideration. It is a thing to be undertaken, if at all, in a thoroughgoing way. Representatives must be selected by the employees with absolute freedom. In order to prevent suspicion on any side, selection should be by secret ballot. There must be equal freedom of expression thereafter. All employees must feel absolutely convinced that the management will not discriminate against them in any way because of any activities in connection with shop committees. Meetings should be held frequently and regularly, not merely when specific disputes are threatened. Both sides must be prepared to study the problems presented and must give them patient, serious, and open-minded consideration. There should be made available those facilities and facts essential to the formation of soundly based conclusions.

Employee representation offers no royal road to industrial peace. No employer should suppose that merely by installing some system of shop representation he can be assured, without continued effort, of harmony and increased production. Doubtless there will be failures where the plan is adopted as a fad or a panacea. It is only a means whereby sincerity of purpose, frank dealing, and the establishment of common interests may bring mutual advantage.

The development and maintenance of right relations between employer and employee require more than mere organization. Intelligent and wise administration is needed of all those problems of production that directly touch the employee. Conditions affecting human beings in industry were, during the last generation, largely in charge of men whose special training had been devoted to the mechanical side of production. Much study was given to the machinery and processes upon which men worked. But the factors that contribute to the broader human development and satisfaction of the employee and that lead to increased productivity were too nearly neglected. The elimination of

human friction is, even from the point of view of increased production, at least no less important than the elimination of waste in materials, or in mechanical power.

Establishments in which the ultimate management is of necessity widely removed from the employees require provision for specialized study of industrial relations. But the right concept of human relations in industry, which should be the primary impulse of management, is of full value only when it permeates the entire administrative force. Farsighted executives testify to the advantage gained from careful and painstaking efforts to encourage and educate their foremen in the proper attitude toward employees.

A large proportion of men trained in our engineering and technical schools now pass into executive positions. It is, therefore, desirable that these schools should provide courses of instruction in which the psychological and industrial background for human relations work shall be developed. But no amount of education outside the plant will remove the need for the systematic training of the force within.

Some industries have extended the principles of employee representation beyond the individual plant. The voluntary joint councils which have thus been set up in the clothing industry, in the printing trade, and elsewhere are fruitful experiments in industrial organization.

The conference has had the benefit of testimony from both employers and employees who have had experience of the results of employee representation. An enthusiasm has been shown which comes from a sincere feeling of substantial progress in the development of human relations.

The paragraph of this report referring to the entrance of engineering students into executive positions and the consequent necessity for their industrial experience and background is particularly pertinent. Experience is, indeed, the best teacher and only those who have been through the experience mill and who therefore know best the point of view of the average employee can, after acquiring the engineering and economic training, best prepare and apply the principles of organization of industry with successful results.

Specific References

1. LINCOLN, E. E.: "Problems in Business Finance," Harvard University Graduate School of Business Administration, Cambridge, Mass.
2. COOK, W. W.: "Principles of Corporation Law," Par. 651, Lawyers Club, University of Michigan, Ann Arbor, Mich.; THOMAS CONYNGTON, R. J. BENNETT, and PAUL W. PINKERTON: "Corporation Procedure," Book I, p. 45; Book II, Chap. XXI, Promoters; Chap. XXII, The Promoters Legal Status; Ronald Press Company, New York.

3. *Bank v. Church Federation*, 129 Iowa 268 (1906); *Munson v. Syracuse, etc., R. R. Co.*, 103 N.Y. 59 (1886); *Bond. v. Atlantic Terra Cotta Co.*, 137 App. Div. (N.Y.) 671 (1910).
4. DEWING, ARTHUR STONE: "Financial Policy of Corporations," p. 4, Ronald Press Company, New York.
5. LOUGH, WILLIAM H.: "Corporation Finance," p. 170, Alexander Hamilton Institute, New York.
6. PARKER, JOHN S.: "Corporation Manual," p. 366, U. S. Corporation Co., New York, 1928.
7. *Ibid.*, p. 534.
8. *Hudson E. E. Co. v. Tower*, 156 Mass. 82 (1892); s. c., 161 Mass. 10 (1894).
9. COOK, *op. cit.*, Par. 71, 72, 75.
10. CONYNGTON, BENNETT, and PINKERTON, *op. cit.*, p. 35.
11. MORAWETZ, VICTOR: "The Elements of the Law of Contracts," Par. 61; Clark and Marshall, Par. 382, Columbia Press Company, New York; *Wood Harvester Co. v. Jefferson*, 71 Minn. 367 (1898).
12. CONYNGTON, BENNETT, and PINKERTON, *op. cit.*, p. 37; Book IV, Chap. IV, Subscription Lists.
13. COOK, *op. cit.*, Par. 176-181; *Converse v. Gardner Governor Co.*, 174 Fed. 30 (1909); *Myers v. Sturgis*, 123 App. Div. (N.Y.) 470 (1908).
14. CONYNGTON, BENNETT, and PINKERTON, *op. cit.*, p. 40.
15. *Ibid.*, p. 48.
16. HARDING, C. F., and D. T. CANFIELD: "Legal and Ethical Phases of Engineering," McGraw-Hill Book Company, Inc., New York.
17. COOK, *op. cit.*, Par. 707; *Oakes v. Water Co.*, 143 N.Y. 430 (1894); *Federal, etc., Co. v. Loeb*, 147 App. Div. (N.Y.) 737 (1911).
18. *Robins v. Ry. Co.*, 100 Me. 496 (1905); *In re Ballon*, 215 Fed. 810 (1914).
19. FARNHAM, DWIGHT T.: "A Practical Operating Organization," *Administration*, vol. 5, p. 427.
20. WILLIAMS, THEODORE: "Functions of Organized Committees," *Administration*, vol. 2, p. 493.
21. JACOBS, LIEUTENANT-COLONEL W. C.: "Principles of Practical Organization," *Administration*, vol. 2, p. 493.
22. *Ibid.*, vol. 3, p. 494.
23. WALKER, PERLEY F.: "Management Engineering," p. 226, vol. III, Ronald Press Company, New York.
24. "Realizing Flexibility in a Holding Company Set-up," *Elec. World*, vol. 91, p. 669.
25. FETTING, RALPH N.: "Organization for Construction Work," *Administration*, vol. 2, p. 163.
26. PAINE, PROFESSOR FRANK D.: "Iowa Program for Rural Electrification," *Elec. World*, vol. 90, p. 25.

Review Questions

1. In what legal ways does a corporation differ from an individual?
2. Is the Ontario Power and Light Co., Ltd. of Ontario, Canada, a "foreign corporation"?

3. Outline in order the steps that are necessary to create a corporation.
4. Name some of the things that should be investigated before undertaking a new enterprise.
5. What is a promoter? What does he do?
6. If the promotion agency is made up of engineers, what advantages result?
7. What is a prospectus?
8. What is the function of the trustee in the organization process?
9. What governs the content of bylaws?
10. Distinguish between line, staff, and functional types of organization.
11. Give the advantages and disadvantages of each.
12. How is responsibility fixed in an organization?
13. List the advantages to the management of the committee system in a staff organization.
14. What is the function of the organization chart?
15. Is dual responsibility workable in organization charts?
16. What would be the effect of dual subordination?
17. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:
T F An organization chart is of value in fixing responsibility of officers of a corporation.
T F Dual subordination works satisfactorily in an organization.
T F In a large and complicated industry the pure line type of organization is always satisfactory.
T F To establish responsibility, the line type of organization is preferable.
T F Modern business usually employs a combination line and staff organization.

CHAPTER VII

REORGANIZATION, CONSOLIDATION, AND MERGER

Mergers and combinations of companies are undertaken in order to produce and permit economy in raising new capital, to bring about economies and betterments in operation, to stimulate the marketing of products through unified control and management, or for all of these reasons.

Like other large businesses, the power and lighting industry is now in the midst of a period of reorganization into larger units. Operating companies in our industry are being merged, and holding companies are being combined into bigger ones or being grouped together under common control. The reasons for this are the same with us as the reasons which are back of similar developments all over the business world. Conditions of American business life have changed, and methods and machinery have had to change in accordance with those changed conditions. Mass production, mass merchandising, and vast capital requirements make necessary business setups on a different scale from those existing before the World War. The demands of today on business are great. Great business organizations are necessary to meet these demands properly. . . .

The public will accept these mergers and consolidations, will approve and welcome them, in fact, just exactly as soon as it is convinced they are in the public interest as well as in our interest. Benefits to society at large must come out of them as well as benefits to the companies concerned. These must be benefits that can be measured, understood, gossiped about by the rank and file of our customers.¹

Such are the cogent phrases with which a well-known public utility executive combines "public relations" with "big business."

Formerly the work "reorganization" and frequently the terms "consolidation" and "merger" connoted the results of failure and bankruptcy. Such meanings still obtain, but their most important application now relates to the rapid expansion of business in the last two decades and the needs of more economical and efficient business organizations to provide for such expansion.

Although the financial and legal problems of readjustment or reorganization *resulting from bankruptcy* are too numerous and

involved for detailed discussion herein, it may be worth while to sound a note of warning against the all-too-frequent failures of corporations, which usually lead to endless litigation and personal loss. Many forms of poor administration or other business weaknesses may reduce a company's earning power to a point where it is insufficient to pay dividends upon its stock, to provide interest upon its bonds, or perhaps even to pay its ordinary current debts as they become due.

The causes may be entirely without the procroration, as, for example, where the demand for its product slackens, where competition becomes destructive and its competitors have strong financial backing to withstand a price war. On the other hand, conditions may arise inside the company, nearly all of which are traceable to bad management in some form or at some time, that make it necessary to readjust. . . . The causes that are somewhat beyond control are:

1. Changes in public demand. This cause is avoidable, since a business management ought to foresee the change and voluntarily liquidate or change the line of product.

2. Competition. This cause is less a difficulty now than before the creation of the Federal Trade Commission. The real danger is never fair, intelligent competition. This is usually helpful. The true danger is unfair competition, and this is now being eliminated.

3. General business depression. Business depressions are quite certain to occur, but their evil effects may be avoided by competent business managers.

4. Death of important leaders. A one-man business, of course, will die with its master. Proper organization is the only real preventative.

The causes that are avoidable are:

1. Ignorance of business principles. Coupled with this is failure to apply the principles.

2. Negligence.

All other avoidable causes grow out of these two primary causes.

A concern is said to be insolvent when it cannot meet its debts as they mature in the ordinary course of business. If the condition is still worse and assets are less than liabilities, the concern is insolvent under the bankruptcy-act definition of that term and it may be forced into bankruptcy.²

Insolvency and bankruptcy require some form of legal procedure which may be initiated by debtor or creditor and which may result in the appointment of a receiver to operate the business in the interim. He may later settle the business affairs to the satisfaction of creditors or court. If, then, the business is

not entirely sold out or abandoned, the corporation may be reorganized at the will of the stockholders.

Thus one form of reorganization results from insolvency. It may or may not be effected through the agency of bankruptcy proceedings and receivership.

There are certain large businesses that fail but that do not go into the bankruptcy courts. The doors of these courts may be closed, either because the debtor has not committed a so-called act of bankruptcy, or is not insolvent, in the sense that the assets are less than the liabilities, or because the debtor is a railroad or moneyed concern such as a bank or insurance company, which under the bankruptcy laws may not be put into bankruptcy. (Large concerns frequently come under the class of concerns that are insolvent in the sense of being unable to pay debts as they mature, but of having sufficient assets, at a fair value, to offset the debts. A concern cannot be put into bankruptcy unless the insolvency is one of the balance-sheet variety.) Such concerns frequently represent huge sums of capital that must be kept together. To break up the plants and sell the machinery and the rest of the property in separate parcels would simply mean the loss of the most valuable assets of all—the organization of the parcels into a money-making machine. Such concerns are generally reorganized. . . .

Reorganizations have three main purposes:

1. Obviating the difficulties that made the reorganization necessary.
2. Supplying the funds needed to give the reorganized company a fair start.
3. Assuring a safe management that will see the company through its period of difficulty.³

Purposes 1 and 2 involve financial reorganization and probably a reduction, or at least a change of form, of the capital. This process frequently requires one or more of the following expedients:

- a. The grouping or replacement of small subsidiary bonds with a single larger bond issue which may be marketed at a lower interest rate.
- b. Combination of junior mortgages into a second or first mortgage at lower interest rate or a substitution of preferred stock therefor.
- c. The substitution of common stock for the obligations connected with preferred stock.

Purpose 3 and possibly purpose 1 involve personnel problems which are local and highly specialized in character and therefore beyond the scope of this discussion.

Reverting, therefore, to purposes 1 and 2, we find that reorganization in the main is simply a change of capital structure which may or may not change the identity and personnel of the business. Such reorganizations, particularly when undertaken by public utility corporations in the interest of expansion and further economies or better service, usually take the form of consolidations or mergers, which, in turn, frequently result in holding companies. The latter are therefore considered of sufficient importance in the public utility field to warrant the independent discussion of the next chapter.

The magnitude of this process of transition for public utilities, which was at its height in the year 1926, may be indicated by the fact that during the first seven months of that year alone reorganizations involving new financing for holding companies were effected in an amount approximating three billions of dollars; this represents 29 per cent of all the new financing taking place in the United States during that most active period.

These refinancing processes, involving as they do various combinations of capital of the initial corporations, are frequently referred to rather loosely and interchangeably as consolidations, mergers, or amalgamations, thereby tending to confuse the definitions of such activities. The distinction between the various methods that are frequently adopted to bring about corporate changes should be carefully considered.

A "consolidation" usually implies the combination of two or more corporations *to form a new corporation*. An identity, separate and distinct from the constituent companies, is established for the new corporation even though the name of the new company may correspond to that of one of the consolidated companies.

Thus, suppose the following represent the balance sheets* of two companies, A and B, respectively:

Company A			
ASSETS		LIABILITIES	
Real Estate	\$100,000	Capital Stock	\$150,000
Machinery	25,000	Accounts Payable	25,000
Inventories	60,000	Surplus	23,000
Cash	3,000		
Accounts Receivable	10,000		
	\$198,000		\$198,000

* For a better understanding of balance sheets, see Chap. XIX.

Company B			
ASSETS		LIABILITIES	
Real Estate	\$ 50,000	Capital Stock	\$100,000
Machinery	15,000	Accounts Payable	6,000
Inventories	25,000	Surplus	10,000
Cash	8,000		
Accounts Receivable	18,000		
	<hr/>		<hr/>
	\$116,000		\$116,000

In the process of consolidation, Company Y is organized with a new capital stock of \$250,000, thereby taking over the assets of both A and B companies, usually at their book value, and assuming their liabilities. The balance sheet of the new Company Y would thus become:

Balance Sheet of Y Company			
ASSETS		LIABILITIES	
Real Estate	\$150,000	Capital Stock	\$250,000
Machinery	40,000	Accounts Payable	31,000
Inventories	85,000	Surplus	33,000
Cash	11,000		
Accounts Receivable	28,000		
	<hr/>		<hr/>
	\$314,000		\$314,000

A "merger" of Company B into Company A, however, would involve an agreement whereby Company A purchases the assets and assumes the liabilities of Company B and, in order to complete this purchase, enlarges its capital by the sale of additional Company A stock to the extent of \$100,000. The new balance sheet of Company A in this case would not necessarily differ from that of the consolidated Company Y, although the intermediate steps would vary somewhat and the identity of the Company A name and good will would have been retained.

The term "amalgamation" of corporations, now less frequently used than heretofore, connotes a process similar to "consolidation" except that the coalescence and virtual disappearance of a group of business organizations is usually implied since the new corporation has an identity comprising all the former corporations.

From a legal point of view there is a distinction between a "consolidation" and a "merger," or the actual sale of one corporation to another. The former results in the union and continua-

tion of the interests in the property while the merger or sale terminates the interests of the owners of the merged corporation.

The method of merger is, therefore, less frequently adopted. There is usually some advantage to the enlarged company in continuing the corporate existence of its subsidiary. Companies which have been operating for some time and which have acquired a favorable reputation and good-will value in connection with their names are frequently retained more or less intact as subsidiary companies. Thus the holding company has attained its marked popularity during the last two decades.

The various policies of combination thus defined are not carried out without considerable careful planning and missionary work. A typical reorganization, involving the appointment of a receiver, is briefly outlined by Gerstenberg as an example of a comparatively simple form of such a proceeding:

In the first place, to prevent conflicting claimants from seizing property, a receiver is applied for. This puts the custody of the property in the hands of the court and preserves the property as a unit till the conflicting claimants can agree upon a plan of reorganization. The various claimants then form committees, the moving spirits in the committees being the bankers who originally sold the issues, or the bankers, insurance companies, and others who hold large quantities of the issue. Thus there may be five or six committees that will eventually be represented about the "peace table." In order to assure that what the committee thinks is right will be agreed to by all the other holders of the same securities, the committees advertise for "deposit of securities." This, in effect, means that the depositing security holders constitute their committee their plenipotentiary attorneys to look out for their interests.

Then comes the jockeying for position by the committees. It must not be thought that the arrangement of interests in the new reorganized company is a simple matter, dependent entirely upon legal principles. Indeed, in many instances economic problems, the answers to which must come from competent engineers and accountants, determine the new alignment. A simple example must suffice. Suppose *A* bonds have a first mortgage upon property *A* and a second mortgage on property *B*, while *B* bonds have a first mortgage on property *B* and a second mortgage on property *A*. From the legal point of view these bonds are on an even footing, each being secured by a first and second mortgage. But if property *A* has greater earning power than has property *B*, clearly *A* bondholders are in a better strategical position than are the *B* bondholders. To decide these questions it is customary

to get an engineering and accounting report upon the value and earning power of the different parts of the company.

When most of the committees have agreed upon a plan, it is put into execution by means of a foreclosure sale. A new company is formed pursuant to the plan, and those who agree and do what is required of them get interests in the new company.

Since it is essential to the success of the reorganized company that practically all the interests agree and come into the new company, paying such assessments as are required of them, it is usual for a banking syndicate to underwrite these assessments, the underwriting agreement providing that for a certain compensation in stocks and bonds the underwriters will pay the assessments of all the old security holders who do not come in.⁴

Such is the average procedure in reorganizations resulting from failure or inefficient business development. It is controlled by referees in bankruptcy, by receivers, or by the courts.

Many reorganizations, however, particularly in the public utility business, are not the result of failure of the initial corporation, but rather of an attempt on the part of the officers and stockholders to acquire for their corporation some of the advantages of amassed capital, interconnection, and centralized management which will be discussed in detail in the following chapter on the holding company.

Such capital changes are usually proposed and frequently perfected with less publicity outside the fraternity of stockholders and may not always, unless carefully regulated, prove to be of the "greatest good to the greatest number" of the citizens or consumers. In most states, however, as previously noted herein, such reorganizations of public utility corporations are subject to the regulation of the state public service commissions. In this process of regulation during the past thirty years a mass of precedent has been established regarding corporate reorganization for which detail reference should be made to such publications as the "Public Utility Reports Annotated of Rochester, N.Y."

For example, it is a general conclusion that the capital stock of the consolidated corporation should not exceed the aggregate of the capital stocks of the consolidating corporations. Whether this refers to stock only or whether it also includes the funded debt was a matter for interpretation by the Public Service Commission for the Second District of New York. The New York statute reads:

"Nor shall the capital stock of a corporation formed by the merger or consolidation of two or more other corporations exceed the sum of the capital stock of the corporations so consolidated, at the par value thereof, or such sum or any additional sum actually paid in cash."

In construing this statute, the commission said:

The purpose behind the statute, however, is perfectly clear. The provision of law in question is designed to prevent those large increases of capital issues which have so often accompanied the consolidation of public service corporations in the past, and which have imposed heavy burdens upon municipalities in the way of inadequate service and excessive prices through the endeavor by the overcapitalized company to earn interest and dividends on the excessive issue of securities. If this beneficent purpose of the statute can be evaded . . . by leaving the aggregate capital stock unchanged, but imposing the same burden upon the community through a greatly increased issue of bonds, the statute totally fails to accomplish the intended purpose.*

This requirement does not overcome the objection frequently directed toward the early increase of capitalization after the consolidation has been perfected or the exchange of consolidated stock for that of the subsidiary companies at widely varying ratios of discounts or premiums when referred to the previous values of the individual companies. Furthermore, a merging corporation must possess, before the merger takes place, every share of the capital stock to be merged. To do this the corporation may have issued its own securities or used its surplus. When this has been done, however, the act of merging does not alter this new capitalization of the merging corporation. Although the various states regulate public utility securities, and in some cases those of consolidations to some extent, the usual interstate affiliations attending such transactions and the involved interrelations of the merging companies have caused many difficulties in the process of regulation by any one state. This condition, upon which a great deal of active discussion is taking place at present, is most concisely outlined by Ignatius as follows:

One way in which consolidation may make difficult the application of public control lies in the massing of accounts covering possibly several municipalities wherein different rates are charged or different conditions

* *Lockport Light Heat and Power Co.*, 1 P.S.C. Reports (and D., N.Y.) 12 (20).

of rendering service prevail, so that upon an inquiry into rates the commission might be confronted with a situation where the costs of service and the value of separate plants in the several municipalities could not be determined. To safeguard against this, the commission has, in a number of cases, required the consolidated company to keep its accounts separately for the territories served by the constituent companies. There is no reason why such requirements should be made only of consolidated companies; [unless the new accounting system necessitated thereby proves to be a departure from the recognized standard and an excessive expense as it has been shown already in at least one state] both the public and corporate interests are better served where costs of service, so far as they may be allocated, applicable to separate communities, are kept by themselves. Such, in fact, is the usual practice; the problem is not so much the introduction of a new method as the perfection of the existing methods through better records and more correct bases of allocating "overhead" and general expenses.⁵

It is fair to say that both the consolidation and merger are being looked upon at present as necessities in the economic growth of large industrial and public utility enterprises.

Whereas the U. S. Supreme Court has ruled that the control of competing businesses by means of a holding company is illegal if done in a manner to violate the Sherman Anti-trust Law, yet the use of a holding company is not illegal when the control exercised is not in restraint of trade and does not tend to lessen competition or create a monopoly. Holding companies created for purposes of economy in operations are not illegal. The Clayton Act of 1914 forbids corporations engaged in interstate commerce from acquiring part of the stock of another corporation under certain conditions, when the effect may be to lessen competition, to restrain trade, or to create a monopoly.⁶

In the case of public utility corporations that have been recognized as monopolies, the advantages of consolidation or merger are particularly noteworthy, especially in the cases where the interconnections and resultant improved service of the more economical systems are made possible thereby. Unless capital values are unduly augmented by such combinations, which values must later be reflected in rates higher in proportion than the economies effected, or unless individuality of accounts is lost to the process of regulation of the commission, the many favorable results of holding companies, which are outlined in the next chapter, as special cases of consolidation and merger, will be

enjoyed by practically all the consumers as well as by the stock-holders of the future public utility corporations.

Specific References

1. SLOAN, M. S., past president of the National Electric Light Association: "Consolidations in the Electric Utility Industry," *Nat. Elec. Light Assoc. Bull.*, vol. 16, no. 10, p. 629.
2. GERSTENBERG, CHARLES W.: "Principles of Business," p. 170, Prentice-Hall, Inc., New York.
3. *Loc. cit.*
4. *Ibid.*, p. 180.
5. IGNATIUS, MILTON B.: "Financing of Public Service Corporations," p. 421, Ronald Press Company, New York.
6. MONTGOMERY, R. H.: "Financial Handbook," p. 723, Ronald Press Company, New York.

Review Questions

1. What is the purpose of a reorganization?
2. In what respects does a consolidation differ from a reorganization?
3. In what way does a merger differ from both a reorganization and a consolidation?
4. In what way might the Clayton Act of 1914 affect consolidating or merging of companies?
5. In the case of public utilities, what governmental body or bodies are charged with looking out for the interests of the general public in matters of consolidation or merger?
6. What advantages would result from the merger or consolidation of two light and power utilities operating in the same city?
7. Two companies *A* and *B* decide to consolidate. What becomes of the assets and liabilities of both companies?
8. If Company *B* merges with Company *A*, what becomes of the assets and liabilities of Company *B*?
9. What is the principal advantage of a merger over a consolidation?
10. What is the principal advantage of a consolidation over a merger?

CHAPTER VIII

HOLDING COMPANIES AND INVESTMENT TRUSTS

The people of the United States do their telephoning on 20,100,000 telephones. Of these instruments 15,500,000 belong to the Bell System. There are 4,500,000 telephones belonging to *connecting* companies. The remaining 100,000 telephones belong to *competing* companies in which the Bell System has no physical connections.

The Bell System is essentially a monopoly, but not an unregulated monopoly. There are forty-five state public service commissions and the Interstate Commerce Commission,* all with jurisdiction over telephone rates. . . .

There are three major divisions in the telephone business. One is A. T. & T. One is the Bell System. One is Western Electric, Inc. A. T. & T. is partly a holding company, partly an operating company, partly an organization for research. As an operating company it operates the long lines. As a holding company, it owns 93 per cent of the common stock of twenty-one operating telephone companies of the Bell System in the United States.

It owns a little less than one-third interest in the Bell Telephone Company of Canada. It owns 98 $\frac{3}{10}$ per cent of the Western Electric Company, the manufacturing end of the Bell System, and the A. T. & T. and the Western Electric jointly own the Bell Telephone Laboratories, the research end of the Bell System.¹

Capital investment in the electric utilities of the country amounts to over eleven billions of dollars, while the various plants are owned by a million and a half customers of the various electric companies, are loaned capital by more than a million bondholders, and are indirectly involved by millions of bank depositors and owners of insurance policies. Since the World War the development of public utilities, and particularly of electric utilities, has been especially remarkable. In 1925 there was an increase of more than 12 per cent in the total output of electrical energy in the United States, while in 1930 the output

* Regulation changed to Federal Communications Commission in July, 1934.

totaled over 100,000,000,000 kw.-hr. of energy.* Customers increased in number to over twenty-five million in the year 1930 although the consolidation of companies into more efficient and economical groups reduced the number of such groups from a maximum of 6,543 in 1917 to only 2,801 in 1929. Eighty-seven million people living in electrically lighted homes in the year 1930 represented 71½ per cent of the population of this country.

Now, note that over 50 per cent of this service is supplied to the public through seventeen large corporations or groups of corporations which may be classed as holding companies. Every one of the so-called holding or investment corporations has a considerable number of subsidiary corporations functioning in the various geographical locations as its operating units. This indicates the high degree of centralization of finance and control which has taken place in a few years.

In many instances not only subsidiary corporations of the same type, such as electric light and power companies (both municipal and suburban), but electric railways and gas companies in addition may function within the same group under the ownership of the same holding company.

The cause of the holding company for electric utilities is therefore well set forth in *Electrical World* as follows:

If this industry were operating with 5,000 separately owned and managed utilities, the waste in money, in man power, and in ill-directed developments would be enormous and service standards would be much lower than they are. The holding company as a fiscal agent, as a manager and consultant, as a commercial operating and financial specialist, brings to bear the highest grade of executive talent upon the development of the smallest utility property. It makes possible enormous savings by bringing about interconnections and bulk power steam and hydro developments. It gives financial stability to the industry and makes possible the raising of funds which are necessary to service developments.

However, if properties are absorbed merely for the sake of acquisition and with little regard for the prices paid and less for the availability of the properties in any well-conceived and properly managed system, trouble is inevitable. All the advantages of the holding company may easily be offset or destroyed by incompetency and by the machinations of the exploiter and despoiler.²

* After the depression this load again reached the old maximum in 1935-1936.

During seven months of the year 1926, which was one of greatest activity for the holding-company organization, \$3,000,000,000 of holding-company financing was completed.

The following electric light and power securities were sold in the year 1928.

90 issues of mortgage bonds (average yield 4.69 per cent).....	\$ 435,810,100
31 issues of debenture bonds (average yield 5.22 per cent).....	420,288,000
17 issues of notes (average yield 5.75 per cent)	66,000,000
50 issues of preferred stock (average yield 5.74 per cent).....	276,884,852
5 issues of common stock.....	38,237,500
Rights and warrants.....	234,277,057
 Total of all issues of year.....	\$1,471,497,509
Estimated local sales to customers.....	170,000,000

Of these total securities sold, a large percentage was that of holding companies and practically all such sales were either directly or indirectly dependent upon the success of holding companies.

Fifty-eight holding-company mergers were reported to *Electrical World* during the year. It is probable that many more were taking place which were not reported.

From these facts, for one year only, it is evident that not only the banks, insurance, and trust companies but every minor investor and consumer is interested in the holding company, its gigantic financial processes, and particularly its present and possible future regulation.

A *holding company* is a corporation formed to control other corporations through the ownership of voting stock. The holding company has virtually taken the place of the trust as originally conceived and operated.

The holding company came into existence in 1889 with the passage of laws in New Jersey, quickly followed by Delaware, Maine, and New York, permitting corporations to purchase and transfer the stocks of other companies. Many states now allow such holding companies to purchase, hold, sell, mortgage, and transfer stock and securities of other corporations and to vote

such stock. Fifty-one per cent ownership of a corporation's voting stock is always sufficient to control it and frequently 40 per cent or less is, in practical operation, adequate for such a purpose because of the large percentage not voting at every meeting of stockholders.

O. C. Merrill, former executive secretary of the Federal Power Commission, is quoted as follows:^{*}

The courts have held that the shipment of and sales of stocks and bonds between the states constitutes interstate commerce,³ and companies holding the stock of other corporations engaged in interstate commerce have been held subject to dissolution or prosecution under the commerce clause.⁴

Charges of the character made by the holding companies upon the operating companies manifestly may be of such amount as to place a burden upon interstate commerce, and it has been held that the power to regulate interstate commerce extends to every person, corporation, instrumentality, act, or practice which may burden or restrain such commerce.

A study of the holding companies, their relations to intrastate and interstate public utility corporations, their engineering and financial advantages, their present lack of state regulation, and the possibility of future federal regulation is, therefore, vital to all intelligent investors, consumers, and utility engineers.

Where the state laws permit, any company whose charter so provides may purchase the stocks and bonds of other companies. A company may, therefore, be both an operating and a holding company. The legal status of the company (known as the subsidiary company) whose stock control is purchased by the holding company (sometimes known as the parent company) is not necessarily changed, nor is its accounting system altered. All dividends declared by the constituent, subsidiary, or operating companies are paid to their stockholders, and the holding company, although controlling these subsidiary companies, receives only such dividends as the ordinary stockholder owning such shares of stock would receive to the extent of his holdings of such stock.

Mr. Samuel Insull always objected to the name "holding company." Many other executives agree that the term is an

* *Elect. World*, Mar. 30, 1929.

unfortunate one. To be thoroughly understood, it must be differentiated from its predecessor—the original holding company of twenty-five years ago. In those days a holding company was exactly what its name would indicate, i.e., a corporation formed for the purpose of acquiring, holding, and selling the securities of other corporations. Such a holding organization was the Standard Oil Company, the tobacco trust, and numerous large aggregations of capital of more or less dubious memory.

The modern holding company, however, is not merely a voting machine or a security reservoir. It is far more than that. It resembles more the British investment trust because of its type of management and its apparent diffusion of risk throughout many subsidiary companies. It is also very frequently a development and managerial corporation. Through a central staff of trained technical experts and experienced utility financiers and managers, a higher standard of construction and operation and a careful supervision of subsidiary management may be accomplished. The primary purpose of such a holding company in the public utility field today should be, and probably most frequently is, not merely an increased financial return, as in the case of the early trusts, but rather operating and financial control of many company units for the purpose of more profitable economic management and better service to customers or consumers.

To understand best the holding companies, and especially those of the managerial type so frequently adopted in the public utility field, it may be well to analyze the unfavorable criticisms that have been directed toward them from time to time and to contrast these with the advantages that have been considered to apply, at least in some specific cases, if not under all conditions, to that form of organization.

Professor W. Z. Ripley, Nathaniel Ropes Professor of Political Economy at Harvard University, in his most enlightening article in the *Atlantic Monthly* for January, 1926, and in his subsequent book entitled "Main Street and Wall Street," has set forth, in connection with his long-predicted but unfortunately little-heeded warning of the recent financial depression, some of the possible criticisms of the holding company; these have been abstracted below:⁵

1. It takes voting control from the hands of many owners and places it in the few.

Corporations have always been susceptible to control by concentration of voting power. Far less than half of the capital stock may be as effective for such control as possession of an actual majority. But it is elemental—requiring no proof—that, the larger the number of shareholders, the more easily may a small concentrated block of minority shares exercise sway over all the rest. With a dozen owners, probably 51 per cent will be necessary for dominance. With 300,000 scattered holdings, a possible 15 or 20 per cent of the votes can never be overmatched at an election. In 1923 there were 250,000 new stockholders registered in the electric light and power companies alone. The total number of stockholders in all sorts of concerns has almost doubled since 1900, rising to an aggregate of 14,423,000 in 1923. These shareholders now possess over \$70,000,000,000 worth of stock at par, on the showing of the federal income-tax returns. Such possession used to be confined to the wealthy and the well-to-do class. Now it comprehends the small householder and large numbers of wage earners. The former concentration of wealth is now yielding place to so wide a diffusion as to call for public recognition by way of legislation or oversight. But the important point to note is that, the wider the diffusion of ownership, the more readily does effective control run to the intermediaries. Financially, the matter is dangerous, for it tends to transform a contingent outstanding charge upon earnings into virtually fixed charges thereon. The cessation of dividends, either to employee holders or to consumers, is bound to be so productive of discontent and unrest that every nerve will be strained to the utmost, even overlong, to prevent their cessation.

It is at just this point that some of the provisions at law, particularly those which abrogate the shareholder's rights to participate in new issues of securities, come into play. Such clauses, with devilish ingenuity, look sound enough above the water line; but they certainly will not stand examination in dry dock. For not only has the shareholder parted with every vestige of control of the enterprise represented by his investment, but now he makes a free gift of such rights as may accrue, resulting from future growth of the property. Heretofore it has been a fundamental rule in corporation law that there shall be no discrimination whatsoever between shareholders. Discrimination there may be between creditors and owners; but by this device even the common shareholders are now set off, to the end that an inordinate share, if, indeed, not all, of the increment of profits in future shall attach to the holdings of those who are "in the know."

Why do stockholders submit to such indignity? The technique is simple, relying upon a fundamental attribute of human nature. Mr. Robert F. Herrick of Boston, in a frank address on holding companies, describing the manner in which the exchange of shares in one corporation for those of another may be brought about, thus puts it:

"All the stockholders act like a flock of sheep. In the main they follow the lead of the directors, and, if the details of carrying the plan through are so arranged that the stock in the new company has an apparent money value greater than the stock of the old company for which it is offered, the exchange once started takes place generally, and when a majority of the stock in the companies is exchanged, practically the consolidation is effected." There you have it in the words of an expert!

2. Stocks and bonds are pyramided and diversified with resultant excessive prices and possible dividends. An illustration of the possible objectionable features of such practices is quoted from Professor Ripley's "Main Street and Wall Street" as follows:⁶

The Atlantic City and Shore Railroad Company had proceeded under its charter to extend its operations through acquisition of all of the bonds and stocks of a connecting railway company. It claimed its right so to do under the then unique provision of the New Jersey law authorizing its domestic corporations, contrary to the general practice, to hold stocks in other companies. The court in disallowing the arrangement thus states its objection—an objection germane also of course to the whole device of the holding corporation:

"For it must not be forgotten that stock ownership by one company in another is only a mode by which the former company engages in the business of the latter. . . . But since the second company might likewise hold stock in any other corporation or corporations, and these might do the same ad infinitum, stock ownership in any company under such a system would not evidence a participation in a 'blind pool,' subject to the uncontrolled will of the majority. There would be an end at once of all practical force of the doctrine that a certificate of incorporation evidences a contract between the state and the corporation or between the corporators or stockholders themselves. For an agreement imports an obligation to do some things and to refrain from doing other things. Without defining terms and bounds there can be no agreement.

"Thus if the Atlantic City and Shore Railroad Company, upon being incorporated for the avowed purpose of constructing and operating a specified line of railroad . . . has the unlimited power to purchase stock and bonds of any other corporation . . . it may purchase not only the stock of a traction company in Atlantic City, buy the stock of a mining company in Colorado, or may participate in like manner in any conceivable business or speculation in any part of the civilized world. Its articles of association would afford no evidence, either to the law officer of the state or to intending purchasers of its shares, as to the actual scope of its activities; nor would any investor have the slightest assurance

that the money he intended to embark in a railroad enterprise in Atlantic County, or the earnings of the capital already embarked, would not be diverted into schemes that he has no means of foreseeing." (Ripley 72.)

3. Possibility of secrecy and defiance of regulatory commissions. (The difficulty of state regulation of a holding company, incorporated in another state, is pointed out in Chap. XXVI.)

In the days before corporate jazz, the Rock Island Railway setup of 1900, which imposed two holding companies upon the operating property, was regarded as downright scandalous. But that was almost a generation ago. Here we have six piled one on top of another, and the practice is so common as to arouse no gossip whatsoever. It will be noted, furthermore, that these heaped-up concerns are not loosely held by ownership of a bare majority of stock. That feature is a phase of concentration of control. This one, characterized by heaped-up corporations bound together by ownership of all the stock, is distinctively an American development. Nor can the phenomenon be fairly laid upon the doorstep of the industry itself. It is an outcome of our federal form of government, and of the conditions under which these companies, pursuing their "tramp and bauble existence"—to borrow a phrase from the Supreme Court of Kansas—are spawned. The keynote is found in the variety of states, indicated in the exhibit, which have a hand in their forthputting. Thus, as Abraham Lincoln once said, in enumerating the assets of a client of doubtful standing, "Last of all, there is in one corner [of the office] a large rat hole which will bear looking into." Non-uniformity of state corporation laws, however, is no rat hole. It is as deep as a well and as wide as a church door, and, as experience shows, it is enough. . . .⁷

Utility managements are less to blame for this overextended situation than are the people of the United States. Corporations are oftentimes compelled by the diversity of state laws to resort to these artificial arrangements—albeit perhaps not without a modicum of quiet satisfaction that our conflicts of laws are so badly permissive of profitable indirection. Thus many states require that public utilities be conducted by domestic corporations; else they may be denied the enjoyment of such rights as that of eminent domain. Hence the domestic operating concern has to be controlled by a holding corporation chartered elsewhere, in order to couple up these local privileges with others which may alone be attainable by going abroad. A case of Jack Sprat and his wife—"and so betwixt them both they licked the platter clean!" The Minneapolis General Electric would forfeit its charter were it to transfer its properties to a foreign corporation. The only thing to do is to keep it alive and hold its stock from elsewhere, catch as catch can.

Minnesota also lays a double liability upon stockholders in public utilities. Marketability for Northern States Power stock would be impaired thereby; hence one markets customer stock of a holding corporation, elsewhere chartered without this double liability. Indiana may require a vote of 75 per cent of the stockholders of an Indianapolis public utility in order to validate a mortgage. Utilities, power, and light can perhaps corral only $71\frac{1}{10}$ per cent of the stock. Off we go to Virginia for a charter creating an intermediary corporation, which proceeds, not to mortgage the property, but to mortgage its holdings of stock in the corporation which does hold the property. Sometimes, it must be confessed, these complications are the outcome of inconsistencies between the financial fashions of different eras, or of the incompatibility of one company with another. Anyhow the mixup is just as confusing.⁸

4. Books of holding companies are not usually available to state regulatory commissions.

5. Losses are more easily concealed and profits more readily withheld than in the single and therefore more simple corporate organization.

The holding corporation is a peculiarly troublesome and confusing business as respects accounting. Even with the best of intentions it is extremely difficult to set forth the true condition of affairs, either as to the estate itself or as to the current income therefrom. The American International Corporation, for example, is largely a finance concern. It has no outstanding bonds; but its income, being derived entirely from investments, is based, so far as these investments are stocks, upon dividends which can be paid only after the satisfaction of the fixed charges of each separate company owned. Nothing less than a complete disclosure of all of these investments makes clear the financial status of the concern. Examination of the published statements of the Associated Dry Goods Corporation, which, by the way, does not even vouchsafe figures for the gross volume of its business, so that one can only make a guess as to the trend of its operating ratio, reveals how cryptic such an outgiving of a holding company can be.

The danger of incomplete disclosure is especially accentuated in the field of public utilities. The Electric Light and Power Corporation in 1925 asserts clearly enough that it has no funded debt; yet its subsidiaries, whence all of its income arises, have in fact \$140,000,000 of such indebtedness. So also with the American Superpower Corporation, which reports no funded or floating debt. Yet its two principal investments are bonded up to almost \$50,000,000. If, with good intent, the

true status may thus be obscured, how great is the danger when the morale is low. The bitter experience of United States Rubber shareholders in 1915 is matter of history. The United Dry Goods Company collapse, coincident with the failure of the H. B. Clafin Company, was a public scandal. Published reports gave no indication of weakness in the top corporation, which, however, was contingently liable for over \$30,000,000 on notes of its subsidiaries. The Corn Products Company in 1903 manipulated matters another way round. A highly discouraging balance sheet was issued, cutting its surplus by over \$2,000,000. This holding company, of course, had no income of its own, so that, when its principal subsidiary, the Glucose Sugar Refining Company, was caused to postpone its dividend date to the succeeding fiscal year, this, and other things of the sort, completely transformed the picture presented by the balance sheet.

It is clear, therefore, that no annual report is worth the paper upon which it is printed, without complete consolidated statements, both of income and of condition, as of a date certain. Many corporations now recognize their obligation to make conditions clear in their entirety, knowing full well that the condition of the holding company standing by itself is almost meaningless.⁹

6. Supervisory charges of holding companies (such as that of the American Telephone and Telegraph Company) may be assigned for engineering and overhead and become a part of the rate problem of the subsidiary company within the various states.

Other criticisms from several sources, some of which may be inferred from Professor Ripley's book, are:

7. The operating management is not necessarily dependent upon financial results.

8. Small capital invested in minority stocks, with more or less apathetic stockholders, may control many subsidiaries.

9. Some such corporations are said to exist only on more or less confidential paper whose transactions are therefore difficult to analyze.

10. Common or interlocking directorates may exist between holding and subsidiary corporations.

11. The lag or slow interaction between the needs of the subsidiary and the decision and action of the holding company sometimes unduly retards progress.

12. Management and control from a distance, without an intimate knowledge of local conditions, may discourage local and individual initiative.

13. The price paid for subsidiaries when competition exists for such between rival holding companies may result in valuations difficult of adjudication later for rate-making purposes.

Commenting upon this criticism in an address before the Great Lakes Division of the National Electric Light Association, Professor T. J. Grayson of the University of Pennsylvania said, at the height of the competitive scramble for subsidiary utilities:

Now here again we are badly in need of some canons to guide us in the mad race for competitive acquisition. Let me insist, therefore, that mere size is not an ideal to be striven for and may be a most dangerous asset. It is well, in fact it is imperative, for every utility company to provide for the future. Indeed, in no other phase of human effort is so much thought given or so much money spent in providing for the necessities of the years that are to come, but provision for the future and the purchase of numerous subsidiary corporations at high prices are two very different and distinct things. Therefore, let me say that in my judgment a subsidiary should never be acquired by a holding company unless its acquisition is necessary in order to enable the holding company to perform its business better and more economically. Every purchase should mean a saving in expenditure, an increase in efficiency, and very possibly a wise provision for the necessities of the future.¹⁰

The matter is expertly described in the words of President Samuel Ferguson of the Association of Edison Illuminating Companies in 1926:¹¹

"In defence of the practice of purchasing operating companies at several times the face value of their existing capitalization and consolidating them into a new company on the basis of the purchase price, it has been urged that the customer cannot be affected by the number of pieces of paper issued by the new company, since he is protected by the limitation of earnings to a fair return on the value of the property. Theoretically, this is so, but practically he does not have a full protection from injury unless injury is by definition limited to the rates charged. The injury from inadequate service and the inability of a company to care for the growth of a community are quite as real, and often much more serious, and yet this must be the result in the case of an overcapitalized company which, through its limitation to a reasonable return on the property value, has earnings insufficient to maintain its credit. The public has had enough of receiverships in the recent trolley situation, and would yield to the demand of a company to be allowed to earn more than a reasonable return in order to maintain its credits as being the lesser of two evils. Consequently, we must shape our course in such matters with a clear knowledge that the public has an interest in the extent of the capitalization of our companies and that, if our

liberty of action in this respect is abused, as it is today being abused in some cases, there will be an eventful day of reckoning, and when that day comes it may not be possible to separate the sheep from the goats.

"When a company is sold for many millions of dollars more than has, apparently, been paid into the treasury for the purpose of providing facilities for service, we must realize that the public is bound to sit up and take notice. What the public sees is that only a comparatively small fraction of the purchase price is represented by what the company receives for the stock at the time of issue and that the new owners must of necessity earn a return on the whole of the price paid; therefore, regardless of the soundness of the reasons which may justify the transaction, it is only natural to expect that the public will insist on being convinced that its interests are fully safeguarded, and apparently it does not today feel at all sure that such is the case. It is, indeed, a very curious situation which exists at the present time in that the stocks of our operating companies are of so great real value to the holders, due to the future equities contained in the same, that they should not be parted with except for a price so high as to make the recapitalization of that price a potential cause for future antagonism."

This is a real problem; and one which cannot be avoided by simply refusing to accord its recognition.¹²

14. The inexperienced investor is too likely to be unduly attracted away from a well-protected bond or stock investment in a small company to a temporarily more promising holding-company stock having less or no protection whatever.

A particular menace lies in the appeal, often under guise of a plea for simplification of an involved corporate structure, for the little holder of bonds of a local operating enterprise to give them up in return for shares of the newly created finance corporation. Such exchange of course has to be lubricated by a tempting offer of a larger immediate income from the new securities. First-mortgage bondholders of the Richmond, N.Y., Light and Railroad Company in 1926 are invited to increase their revenue from a bond from \$40 to \$63 per annum by accepting preferred stock in the Associated Gas and Electric Company. Now as bondholders on their local property they had a first claim upon its revenues. As preferred shareholders of the top holding company, there were in 1925 interest charges upon almost \$50,000,000 of bonds which took precedence over them as to income. Whether the added income was worth the change of status is a question of moment, to which the uninitiated give but scant attention.¹³

The danger described above is contemplated in the preamble to a resolution of the board of governors of the Investment Bankers Associa-

tion of America, May 14, 1925, as follows: "It is obvious that, from the standpoint of sound investment, it is inappropriate for many investors to exchange mortgage bonds of operating public utility properties for the preferred and other stocks of public utility holding companies." For obviously by such exchange the uninitiated investor may have shifted his position from that of a preferred to that of a junior claimant upon earnings. The financial record of preferred issues of operating companies is on the whole excellent. By and large, noncumulative preferred shares in any enterprise are not inaptly described by a leading lawyer as "waifs of the stock market." Honorable Bainbridge Colby, late Secretary of State of the United States, recently pictures the status of such securities as follows: "There is not in New York city a lender on a second or third mortgage who is not in a better position than the average holder of preferred stock of corporations. It is difficult to define the position of the preferred stockholder. He is denied participation in the control of the corporation; he is on the poorest terms of them all." Such securities fall between two stools. The man who holds them is neither a partner sharing in the increment of future growth nor a true creditor with a prior lien upon earnings and assets. They are exposed to the danger of vanishing returns soon to be set forth in another connection, as well as to the possibility, unless duly safeguarded, of the intrusion of new securities with prior claims upon earnings to their own. Nevertheless, within reasonable limits they have proved themselves a present help in time of trouble—that is to say, a handy means for satisfying the gluttonous appetite of this lusty, growing industry for capital. The upshot of this warning, then, is not that their use should be prohibited, but that their possible precariousness should be safeguarded by some substantial measure of public supervision. This the separate states are incompetent to give. The matter lies entirely beyond the scope of their power.¹⁴

15. The last serious indictment against the overdeveloped holding corporation in the public utility field has to do with rate regulation. Under the terrific involution of accounts it may become practically impossible to allocate costs and to determine earnings as related to the investment. The holding company is exposed to the temptation to exploit its subsidiaries, taking its own profit by undue enhancement of the operating expenses of the local concerns. Alpha Company, the operating concern, apparently runs at a loss, while Omega Company, which holds its stock, pays dividends nevertheless. Such things may be accomplished by overloading management expenses. "Too many crossed wires" was the newspaper headline applied to the Massachusetts Public Utilities decision in 1916, when something like \$240,000 out of its total expenditures of \$318,000 was paid by the North Adams Gas Light Company to the Light, Heat, and Power Corporation of West

Virginia for current supplies, construction, and management. How easy for the interstate holding company to dilute earnings in order that they may become digestible in the public view, and how difficult in a massive hierarchy of such holding companies to trace anything like costs in relation to investment back to some solid bench mark. How difficult to pass upon the reasonableness of contracts for use of property or sale of power. This too has recently been brought to the attention of the Massachusetts legislature. Formal proceedings degenerate under such circumstances into a mere muzz of words.¹⁵

Having thus considered all the important criticisms of the holding company, many of which have been forcefully emphasized by various quotations from the so-called "brilliant though somewhat vitriolic pen of Professor Ripley of Harvard University," let us list briefly the rather self-explanatory advantages of the managerial holding company which have been collected from many sources. Their balance of argument in contrast to the objectionable features of such an organization will, of course, vary with each local corporation and will always be dependent upon the difficult comparison between the more or less intangible operating or service values to consumers on the one hand and the risks to investors on the other. Where both functions, i.e., those of a satisfied consumer and those of a satisfied investor, reside in the same individual, which is true to an ever-increasing extent, the individual (combined consumer and investor) must learn the more accurately to balance, in his own mind, the technical versus the financial services rendered by the particular holding company in which he may be interested.

These advantages are:

1. *Diversified investments*, which may be scattered over the entire country and not dependent upon local or limited conditions.
2. *Distributed Risk*.—One subsidiary may be temporarily weak and yet be readily assisted by a more fortunate subsidiary or by the holding company itself. Occasionally a holding company may guarantee interest or dividends on bonds or stocks of its subsidiary companies.
3. *Financing may be carried out more readily* and, in some cases, more economically, owing to:
 - a. Availability of large central markets for securities.
 - b. More favorable interest rates usually available.
 - c. Less discounts or premiums on securities sold by agencies.

4. Holding companies can afford to *employ higher grade legal and engineering talent*, if used for many subsidiary companies, than these small companies could afford.
5. *Broader and more varied resources* for such combined companies are available with respect to:
 - a. Better and more standardized management.
 - b. Operating methods, rules and practices, reports, statistics, trade secrets, cost data, etc., found valuable in one corporation may be applied to all subsidiaries.
 - c. Budgets, premiums, and units of output may be compared more readily within the one organization and economies may be effected.
 - d. Laboratory tests and research determined economically at one central source are available to all subsidiaries.
6. *Operating working capital* may be less, thereby reducing emergency reserves.
7. *Purchases of fuels, materials, and stores may be made more economically* because:
 - a. Quantity discounts may be obtained on large contracts.
 - b. Demands of individual properties are standardized and therefore more uniform.
 - c. Consolidation of purchasing departments reduces overhead charges.
 - d. More time is available for standardization of purchase specifications and quality and cost selection.
 - e. Better credit of larger buyers may provide larger discounts.
 - f. Interchange of equipment, stores, and personnel is possible between subsidiaries, especially under emergency conditions.
8. *Conditions of production are improved* because of:
 - a. Improved design and larger size of operating plants constructed in most economical locations.
 - b. Interconnection of systems, particularly steam and hydroelectric plants.
 - c. Standardization of most efficient methods.
 - d. Loads provided for small automatic hydro plants.
 - e. Efficient use of water power at different periods from different watersheds in the same system.
 - f. Economical use or sale of by-products.

- g. Eliminating duplicate transmission lines and terminal facilities.
 - h. Eliminating the transmission of energy by two companies in opposite directions past one another with excessive line losses for which the consumer must ultimately pay.
 - i. Eliminating the retention of several inefficient power stations operating to maintain continuity of service.
9. *Economics of the Distribution System.*
- a. Flatten the load curve with diversified loads and resultant high load factor.
 - b. High load factor permits higher efficiency and larger revenue for given fixed charges.
 - c. Joint use of personnel and equipment, such as line and safety demonstration crews, trucks, cable, testing apparatus, etc.
 - d. Unified sales organization and policies. Campaign and demonstration organizations moved from place to place to establish new business methods, stock sales, advertising, etc.

It may be argued that many of these advantages are not necessarily peculiar to the holding company, certainly not to the nonmanagerial or investment type of holding company, but are equally available to the large public utility which operates a sufficiently large network to enable it, in part at least, to profit by such economies. Yet most of these advantages have accrued to the public utility business because of consolidation, and most frequently such consolidation has resulted, whether for the above reasons or otherwise, in the holding companies that are now so common.

Much of this development has gradually taken place before our eyes because capital has been needed very rapidly to meet the increasing demands and it seemed the natural and easy way to get the money and to enlarge and interconnect the small systems that had been rapidly outgrown. Professor T. J. Grayson says in this connection:

It would be well to emphasize the fact that the methods of finance employed make little difference so long as the primary objects are reasonably well attained; that is to say, the investor should be well protected and reasonably compensated for the investment he has made, and, when we come to consider the various ways in which this is done

by the more responsible companies, we find that the situation reveals certain general tendencies of the times for each of which there is a powerful motive but which, after all, are very much like fashions in clothes and hairdressing. It is the style today for holding companies to issue stock in large quantities, and, while theoretically much may be said for the old orderly system of senior and junior financing, nevertheless, we should not forget that since the war the industry could not have expanded as it has done if it had depended on the old methods of finance to provide the funds.⁷

This gradual growth of the holding company was exemplified by Martin J. Insull in one of his addresses as follows:

What is one of these holding companies or investment companies? I think I can illustrate it to you, by treating it largely as a personal matter. Let us assume there is some man in Cleveland, whom we will call Jim Brown, who has quite a large amount of money to invest and he is attracted to the electric light and power business or to the utility business in general. Somebody comes up from Illinois and says to him, "Mr. Brown, there is a group of towns in Illinois that have very poor, inefficient electric light service, and the present companies can all be bought out. They are well located because they are near coal, and there is plenty of water so that a generating station might be built at a strategic point and all of these towns grouped together by a transmission system, and the business in the towns and between the towns very much developed." He is attracted to that proposition and agrees to put some money into it. He starts in and buys up the various small electric light plants in this area, and goes ahead and makes his financial arrangements to build the station and the transmission and distribution system.

When he gets through we will say he has a business of a quarter of a million dollars a year and he has invested in round figures something like \$1,250,000, some of which he has had to borrow from the banks, other parts of which he has provided out of his own private means. He forms an operating company. Now, he has an operating company doing \$250,000 a year of gross business, and he has an investment of \$1,250,000 in it, and he arranges with some investment banker to take \$625,000 worth of bonds upon the property and reimburses himself to that extent, or with the proceeds of those bonds he pays off loans he has made at the bank in order to put this project through. He still has, in round figures, \$625,000 invested in the property and so he proceeds to sell, we will say, \$300,000 worth of preferred stock in the territory and reimburses himself to that extent; and finally winds up owning all of the common stock of that particular operating property in which he has invested \$325,000. The property runs along in good shape,

does very well; he has a local manager directing operations, and he goes to Illinois sometimes and looks it over. It is running very nicely, and he is very much attracted to the business. Then somebody comes along from Indiana with a similar proposition and he goes through much the same process, assuming the proposition is of the same size, and ends up with \$325,000 invested in the common stock of his Indiana company.

He now has \$650,000 invested in the common stock of two operating companies. Then, some fellow comes up from Texas and brings to him a third situation down there that interests him, and he goes down there, looks it over, and finally goes through just the same process in Texas.

He now has \$975,000 invested in the common stocks of operating companies in Illinois, in Indiana, and still another one in Texas, and he has about reached the limit of his personal resources. But he likes the business and he would like to go on in it. Then some one comes along from Iowa with a much larger proposition. He is anxious to take that one, but he commences to think it over and he reasons: "Well, now, this thing is getting beyond my personal capabilities to properly finance these properties, and I have got to get in some partners." So he gets a few friends together and somebody says, "Why don't we form a corporation for the purpose of doing this? Why don't we have a corporation and issue its preferred and common stock, sell it to the public, and that will provide the money for us to continue with your plan, Mr. Brown?" And they do that. What have they got then? They have an investment company, or a holding company.

What Mr. Brown did is exactly what the electric light and power investment companies do. Their greatest function to my mind is to provide that junior money as represented by the common stock in various operating properties that they control and which they should rightfully control because they have put their money where there is the greatest risk and where their return is secondary to the money that they have induced the public to invest in those operating properties.¹⁸

Conversely, the comment of Professor Grayson, endorsing in part the criticisms of such practices by Professor Ripley, may be pertinent:

I agree with Professor Ripley that the general tendency observable on the part of many corporations—both utilities and industries—to retain company control within the hands of a comparatively few people is not a good thing from a sociological standpoint, and I also believe that in certain instances it may cause real loss to company investors, but on the other hand I feel that Professor Ripley somewhat overestimates the importance of voting rights to the average holder of common

stock and tends to predict more dangerous consequences than I think are apt to follow from the general situation in the immediate future. I do believe that there is a considerable moral advantage in the possibility of making an appeal to a large number of stockholders in case the management of a company is inefficient or guilty of wrongdoing, and the very possibility of such an appeal being made, even though it may be expensive and difficult to actually carry it out, does have, to my mind, a restraining effect upon the controlling interest of any corporation, utility or otherwise. In this sense, then, I heartily agree with Doctor Ripley and I think his recent article constituted a needed warning and came at a proper time.

There is one vital fact, however, which should not be forgotten by anyone interested in company securities, namely, that an essential difference exists between a bond and a share of stock. Bond interest must be paid if the property is to be retained, and no amount of sophistry can make this true as to a stock dividend. It is also a fact that any investment in a company's securities constitutes a money loan, although technically this is hardly the case when stock is purchased, and money so invested should receive adequate protection. Formerly a bondholder had primary security but no voice in management while the stockholder had at least a voice in management but secondary security. Now frequently a stockholder has secondary security and no voice in the management and this, I presume, is what Professor Ripley chiefly objects to. Nevertheless, it is only fair to state that certain advantages and remuneration usually accrue to the nonvoting stockholder which go a long way in his judgment to make up for his lack of managerial power.

For a considerable period after the close of the war, utility bonds were a drug on the market and it was not until someone conceived the brilliant idea of approaching the people through a new medium and taking advantage of improved conditions of fiscal operation in a novel way, namely, by selling stock direct to customers and consumers, that the situation really resolved itself favorably toward utility corporations and the great era of successful expansion which we are now engaged in began. Therefore we should not be too back-looking in our estimate of the comparative value of new methods of holding-company finance, but should appreciate how well these methods have served the large corporations of today, and only seek to amend them in connection with any defects we may find from the standpoint of the investor's protection and proper remuneration.

We now come to another important standard of holding-company finance, namely, the provision for an equity on the part of the group in control. Under the old scheme of things, after the bond issues and before the common stock, there is a twilight zone which should be occu-

pied by the funds of the management, whether in the form of junior lien bonds or preferred stock. Under a more modern financial arrangement, the managerial equity is divisible into two parts, one of which is usually well provided for. There is in most cases a class of common stock "A" or "B" which represents the controlling equity of the managing body. It is the reward of ownership and we may well say promotion, but does not always represent actual money invested, so that the other part of the equity, and so far as the investor is concerned the more important part, should in such cases be represented by an issue of preferred stock issued for cash or its actual equivalent. In other words, under either scheme of finance, the controlling interest should be anchored to the proposition by cable chains fastened at one end to the corporation's business and at the other end to the owners' pocketbooks. It should never be too easy for ownership to issue new securities, sell them to the public, and then vanish from the scene. One of the greatest dangers at the present time, in my judgment, is the possibility that some of those who have promoted and are now operating holding companies in the utility industry may proceed at a rapid and unconservative rate, and, building their structure upon sand, may reach a point when they will make what is commonly called a "cleanup" and then desert the situation, leaving thousands of innocent investors to bear the brunt of their misdeeds. I wish to state most emphatically that I have no such fear with regard to the leading public utility holding companies, but I do very much fear that some of their imitators may be used for exactly this purpose by unprincipled men.

Another important principle in connection with holding-company finance is the revision of the mortgage situation which frequently takes place. In the old days nearly all utility mortgages were closed and it was many years before it was realized that this was a real obstacle in the way of successful corporate finance. It has been said that a rose by any other name will smell as sweet, but this poetical thought does not apply to mortgages and nothing has been found which proves an acceptable substitute for an absolute first mortgage on a company's property.

Today we see a constant improvement in the construction of corporate mortgages. For instance, the open mortgage without definite amount is a wonderful means of capitalizing a constantly increasing property of a great corporation. In this connection the most recent mortgages of the Detroit-Edison Company are splendid examples and it has been a privilege for me to examine them. So far as particular mortgage provisions are concerned, the gradual acceptance of sinking funds has not only protected the investor but it has definitely attracted him. When I first started to practice utility law, sinking funds were the exception; now they are the rule. Furthermore the old loose substitu-

tion clauses of collateral trust mortgages have given way to carefully drawn and thoroughly protected provisions of a similar character so that I would earnestly suggest that hereafter, in providing for new financing, holding companies give special attention to new mortgages drawn up and executed to carry this financing into successful effect.

One more standard of holding-company finance and I am through. I think it is hardly necessary to point out the excessive dangers of watered stock or other kinds of inflated securities in connection with holding-company finance. This sort of thing simply will not do because the bigger the company, the wider the distribution, the more people will suffer from any action of this character, and consequently the greater will be the whirlwind when it is finally time for the reaping.

In conclusion I would like to insist that there is nothing mystical or esoteric about the financial standards of the modern holding company. Except as to size it does not differ essentially from corporations of the past. In its operation and in its relations with its subsidiary branches it does differ, but not with reference to the financial principles which should guide its owners and operators in their fiscal transactions. We may be conservative and at the same time progressive, and that is one thing that I wish you would take away with you this morning. I do not insist upon any orthodoxy in finance. I am ready to welcome and carry out the system of broad stock distribution which obtains today. I do not insist upon any particular system for strengthening the financial status of subsidiary corporations. It may be done directly or indirectly. I do not care a penny, but I do insist, and that most emphatically, that the object of every action taken shall be to benefit the legitimate owners of the property and the general public which uses its output, and such a result can only be obtained if in the first instance a fair and not an excessive price is paid for the properties controlled, and if, when obtained, these properties are used for the benefit of their own consumers as well as for that of the holding company and strengthened materially for both purposes, and I further insist that they shall not be used as a basis for the issuance of inflated securities which can only lead to disaster.¹⁷

This latter quotation, presented as it was before a group of public utility officials in the year 1926 by a conservative legal and financial authority upon the subject, now in 1936 has almost an uncanny interest and is found to have been clothed with unusual accuracy of prophecy in the light of the financial crashes of the years 1929 and 1930.

Our engineering executives should not jump to the conclusion, however, that all holding-company organization is unsound or

even fraught with top-heavy risks supported by unstable basic fundamentals, but rather they should carefully analyze the advantages and disadvantages of such organizations and demand a conservative financial security which may provide the many valuable features outlined herein for stockholder, bondholder, and consumer.

Although the effect of the organization of a holding company upon the officials and the other employees of the subordinate smaller companies is largely dependent upon local conditions surrounding each case, it is sometimes unfortunate for the non-progressive engineer. While no general rule can be established or results of various experiences discussed at length, the proper attitude to be adopted by the executive toward such a consolidation for the greatest good for himself and the service at large was well set forth in an editorial of *Electrical World*, which reads in part as follows:*

Below the surface in the rising tide of holding-company expansion lies no little unsettlement of mind among many executives whose lives have been devoted to the upbuilding of individual light and power properties. Centralized management has come to stay, and as it comes these men are not to be blamed for questioning the effect of this movement upon their companies and upon their personal prospects. The right mental attitude toward the situation is extremely important, for upon this attitude in the long run depends the whole prospect of future usefulness of these experienced executives under the new regime.

Holding companies are of many kinds and policies. An open mind on the part of the single-company executive is the first essential when facing a transfer of control. Coupled with this should be a determination to cooperate to the limit with the new organization as long as one remains with it. The policy of the best managed holding companies is to throw the door of opportunity wide open before the executives active in the former administration. As in all other lines of business, it sometimes happens that sweeping changes are put into effect when control passes—changes which are too great to warrant continued service on the part of the previous regime. The important thing, however, is not to miss any real opportunities to serve a new management if reasonable conditions appear to be in prospect and to shun prejudice as a pestilence.

Many executives of acquired companies are now men of years. Their value to a new organization may be almost beyond conception provided

* "Executive Readjustments in Holding Companies," *Elec. World*, vol. 89, Jan. 29, 1927, p. 235.

that their minds are receptive and their wills determined to make a success of things under the new dispensation. With the new organization at work, the outlook should broaden. Cheeseparing economies should give way to reasonable expenditures to obtain necessary results on time schedules synchronizing with holding-company standards. Executives should take part in group company conferences and conventions with alert interest and should be both seen and heard—but heard to the point. They should speak well of the new organization among employees and friends. They should do their utmost to secure and maintain cooperation by the entire staff in the operation of the property along new lines, in engineering, sales activity, and accounting, with the adoption when required of new and unfamiliar forms of reports.

Under the right conditions a change of control spells opportunity in capital letters to many an executive, and from every standpoint it is important for such men to see in such opportunity a challenge to the best that is in them. The reward of a right response can be seen today in the executive personnel of holding and operating companies from one end of the country to the other.

Although little has been said about "investment trusts," except to state that many of the principles of the successful British investment trust had been incorporated in the holding-company organizations of this country, it may be well to point out that the practice of not placing all the eggs in one basket should have prevented more broken eggs and broken hearts of investors than it did during the years 1929 to 1932.

The very rapid growth of such trusts in this country from less than \$500,000 capital in 1924 to nearly \$500,000,000 in 1928, coupled with the ambition to direct and operate subsidiaries in addition to the original policy of acting as "financial trustees" alone, no doubt contributed to their downfall.

The principle upon which such trusts are founded, if conscientiously followed, is obviously sound, i.e., they are companies or corporations organized to profit from investments in a *diversified group* of dividend-paying securities, the profits arising from two sources: regular dividends and appreciation of principal. Preferred stock and sometimes debentures are sold to the public and the funds thus obtained are invested in selected securities. With these securities as collateral, the trust is then enabled to borrow additional funds from the commercial banks for further investment.

If the policies of all the investment trusts had been as closely safeguarded as those of the following conservative trust, no doubt the undermining of both values and confidence would not have taken place.

Purchases were restricted as follows:

1. The corporation will not invest its funds in securities of any corporation or organization unless such corporation or organization or its predecessor has been established for at least four years prior to such investment.
2. Not more than 55 per cent of the corporation's funds will be invested at any one time in securities originating in Great Britain and not more than 35 per cent will be invested at any one time in securities originating in any other nation or country except the United States.
3. Not more than 10 per cent of the corporation's funds will be invested in securities representing any one distinct class of business or industry.
4. Nor more than $1\frac{3}{4}$ per cent of the corporation's funds will be invested in securities of any one obligor or issuer except governmental securities and not more than 5 per cent thereof will be invested in the securities of any one government except those of either the United States of America or Great Britain.
5. The corporation's funds will be invested in at least 500 different securities.
6. The corporation will not engage in any promotion, business management, or business financing, and will confine its operations to the investment and reinvestment of its resources in seasoned, marketable securities.

The spirit of the last clause is almost universal among investment trusts, it being the accepted policy to trade in the securities of governments, corporations, or companies rather than of assuming control by the purchase of a majority of the stock. Many of the trusts guide their policy according to the operations of the companies the securities of which they hold, without any intention of influencing the policies of such companies. The directorates are generally authorized to substitute securities and turn over investments whenever it is desirable in the interest of the stockholders. In this way advantage can be taken of market conditions and of factors relating to the operations of the companies concerned.

One of the outstanding features of the investment trust is the exceptionally low operating costs. Statistics show that the expenses of the English and Scottish investment trusts range from 0.27 to 0.63 of 1 per cent of the issued capitalization of the company. Although few United States companies have been able to duplicate this record with regard to

the cost of operations, the most successful trusts have very low operating ratios.¹⁸

It is quite possible that the failures which resulted from the excessive pyramiding of one holding company on top of another are a thing of the past; at least the cases of its misuse are now few. But any discussion of the holding company without some reference to this possible misuse would be incomplete. It is quite apparent that, if one or more holding companies issue securities upon the property equities, already heavily loaded with securities of subsidiaries, it would leave little in assets or earnings in either a foreclosure or a drastic slump in business. For illustration, one large organization which is now endeavoring to simplify its structure has pyramided up to the seventh "layer" of companies. Actual equities in such a structure are apt to be quite small for the company forming the seventh "layer."

The same is likewise true of the earnings available to the holding company. For example, one large holding company in 1925 earned its interest charges more than 8 times over for the year, but the subsidiary companies earned their interest charges only slightly over 4 times for the same year. On closer examination it was found that, if the times interest charges earned on the subsidiary companies' bonds dropped to $3\frac{1}{2}$ times, the interest charges earned on the holding company's bonds would have dropped from 8 times to approximately 4 times. Thus, the strength attributed to the 8 times earned must be considerably modified.

In some of the weaker holding-company structures in which the subsidiaries have been either partially or wholly reorganized, the holdings in street railways were usually abnormally large. In these cases, of course, allowances should be made, for there is an added problem which in certain instances is even of more significance than the thinning of equities through top-heavy holding-company structures.

The simple earning statement [Table IX] of one holding company controlling a subsidiary holding company and the latter in turn controlling a subsidiary group of companies illustrates how quickly quite ample margins may be turned into deficits with a relatively small drop in gross revenues. It can likewise be seen from this illustration how in a similar manner the property equity behind the bonds may be thinned. Not only must one observe the condition of the particular year, but also whether certain factors, such as maintenance, improvements, and the like, have been slighted to maintain the earnings on the holding-company's capital stock.

The problem of Table IX is of most direct concern to the investor in public utility securities. Fortunately, the very rapid growth of the utility operating companies and the rapid and continued absorption of subsidiary companies has in certain cases eliminated any evidence of this condition which previously was developing. Where such a correction

TABLE IX.—ILLUSTRATION OF THE VARIATION IN THE RETURN TO THE HOLDING COMPANY

Subsidiary Companies	First Year, Average Condition	Second Year, Low Point in Gross
Company 1:		
Gross revenues.....	\$ 2,000,000	\$ 1,800,000
Operating expenses, etc.....	1,400,000	1,300,000
Gross income.....	\$ 600,000	\$ 500,000
Interest on bonds.....	\$ 200,000	\$ 200,000
Dividends on preferred stock.....	50,000	50,000
Balance.....	\$ 350,000	\$ 250,000
Dividend on minority interest in common stock.....	50,000	50,000
Net balance to subsidiary Holding Company 1.....	<u>\$ 300,000</u>	<u>\$ 200,000</u>
Company 2:		
Total income of subsidiary Holding Company 1.....	\$ 300,000	\$ 200,000
Administration expenses.....	25,000	25,000
Gross income.....	\$ 275,000	\$ 175,000
Interest on bonds.....	\$ 25,000	\$ 25,000
Dividends on preferred stock.....	50,000	50,000
Net balance to Holding Company 2.....	\$ 200,000	\$ 100,000
Company 3:		
Total income of Holding Company 2....	\$ 200,000	\$ 100,000
General expenses.....	20,000	20,000
Gross income.....	\$ 180,000	\$ 80,000
Interest on bonds.....	\$ 60,000	\$ 60,000
Preferred dividends.....	60,000	60,000
Balance.....	\$ 60,000	Deficit \$ 40,000
Dividends on common stock.....	40,000	.....
Balance to surplus.....	\$ 20,000	Deficit \$ 40,000

	Times interest earned on subsidiary	
	First year	Second year
Company 1.....	3	2½
Company 2.....	11	7
Company 3.....	3	1½

has been brought about and allowed to continue without a further over-extension of the holding company, well and good, but a continuance of the same practice is subject to severe criticism. Public utility growth must eventually reach the point of normal growth, and, when a utility's development has reached that stage, an overextension of the type of company referred to above will be more difficult to overcome. And holdings in such companies would be unfortunate for the investor.¹⁹

Thus we have seen the causes of some of the trouble that underlay the financial crash of 1929 and the magnitude of basic difficulties that have stood for several years in the way of successful reorganization and economic recovery. Such should prove a forceful guard against repetition and yet not eliminate the values that have been shown to reside in conservative holding-company and investment-trust management.

Specific References

1. "World's Largest Corporation: Its Stock," *Readers' Digest*, September, 1930, and *Fortune Magazine*.
2. Editorial, *Elec. World*, May 28, 1927.
3. *Alabama & N. O. Transportation Co., et al., v. Doyle*, 210 Fed. 173, and *Compton Co., v. Allen*, 216 Fed. 537.
4. *N. S. v. Northern Securities Co.*, 193 U. S.
5. RIPLEY, W. Z.: "Main Street and Wall Street," p. 95-97, Little, Brown & Company, Boston.
6. *Ibid.*, p. 71-72.
7. *Ibid.*, p. 294.
8. *Ibid.*, p. 296-297.
9. *Ibid.*, p. 202-203.
10. GRAYSON, T. J.: "Some Standards of Finance for Holding Companies," *Bull., Great Lakes Div., Nat. Elec. Light Assoc.*, 1926, French Lick, Indiana.
11. RIPLEY, *op. cit.*, p. 327.
12. *Ibid.*, p. 328.
13. *Ibid.*, p. 312.
14. *Ibid.*, p. 314.
15. *Ibid.*, p. 309.
16. INSULL, MARTIN J., formerly president of Middle West Utilities Company: "Electric Light and Power Investment Companies," to a class in Public Utility Finance, Northwestern University, 1925, quoted in Lagerquist, "Public Utility Finance," p. 37.
17. GRAYSON, *loc. cit.*
18. CHAPMAN, J. M.: "Investment Trusts Help Stabilize Utility Markets," *Elec. World*, vol. 90, p. 1258, Dec. 17, 1927.
19. LAGERQUIST, WALTER E.: "Public Utility Finance," McGraw-Hill Book Company, Inc., New York.

General References

- CHAPMAN, J. M.: "Investment Trusts Help Stabilize Utility Markets," *Elec. World*, vol. 90, p. 1258, 1927.
- CONYNGTON, THOMAS, R. J. BENNETT, and PAUL W. PINKERTON: "Corporation Finance," Ronald Press Company, New York.
- COOK, W. W.: "Principles of Corporation Law," Lawyers Club, University of Michigan, Ann Arbor, Mich.
- GLAESER, MARTIN G.: "Outlines of Public Utility Economics," The Macmillan Company, New York.
- IGNATIUS, MILTON B.: "The Financing of Public Service Corporations," Ronald Press Company, New York.
- LAGERQUIST, WALTER E.: "Public Utility Finance," McGraw-Hill Book Company, Inc., New York.
- NASH, L. R.: "The Economics of Public Utilities," McGraw-Hill Book Company, Inc., New York.
- RIPLEY, WILLIAM Z.: "Trusts, Pools and Corporations," Ginn and Company, New York.
- "The Equipment Trust Grows in Favor," *Elec. Railway J.*, May 22, 1920.
- "Realizing Flexibility in a Holding Company Set-up," *Elec. World*, vol. 91, 1928, p. 669.

Review Questions

1. In what way does the modern holding company differ from its counterpart of twenty-five or more years ago?
2. List the principal disadvantages of the holding company.
3. List the major functions of a holding company.
4. List the principal advantages of the holding company.
5. Discuss the effect of interlocking directorates.
6. Give a few concrete examples of the disadvantages of absentee engineering contacts by holding companies.
7. Explain by example the pyramiding of stocks that may result when holding companies control other holding companies.
8. Is it possible to have virtual control without owning 51 per cent of stock? Why?
9. Distinguish between a holding company and a trade trust.
10. In what way does the holding-company organization assist in the rapid resumption of service in areas visited by severe storms, floods, etc.
11. Discuss the possible remedies for regulating holding companies engaged in the interstate sale of power.
12. Show how it is possible to control many millions of dollars worth of property with a relatively small amount of stock by holding-company operation.
13. Which of the following are holding companies and are they in your opinion justifiable? (a) American Telephone and Telegraph Company; (b) Atlantic and Pacific Tea Co.; (c) General Electric Co.; (d) General Motors Corp.; (e) United Steel Corp.?

14. a. List five advantages and five disadvantages of the public utility holding company.

b. Illustrate how a holding company is formed from two operating companies A and B.

15. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively.

Holding companies, of the combined fiscal and operating type, usually have the following *advantages* over small individual public utility corporations:

T F Standardized construction methods.

T F Ease of regulation by the state.

T F Community interest.

T F Possibility of normal and uniform profits of small subsidiaries.

T F High-grade uninterrupted service.

Such companies usually have the following *disadvantages*:

T F Greater skill in management and operation.

T F Absentee management.

T F Lack of adequate regulation.

T F Possibility of interlocking directorates.

T F Restoration of run-down utilities.

16. Mark as for question 15.

T F The pure holding company depends upon its subsidiaries for its gross revenue.

T F It is possible to control a company without having 51 per cent of the voting stock.

T F The T.V.A. is not a holding company.

T F Stock pyramiding is possible in a holding company.

T F A pure holding company is always a public utility.

T F A holding company and a trade trust are the same thing.

17. Mark as for question 15.

T F A holding company may be formed by securing the bonds of one or more subsidiary corporations.

T F Interconnection of power systems is always an advantage enjoyed when electric power holding corporations are formed.

T F A subsidiary of a large managerial holding company is often less able to cope with the damage resulting from major storms than one not a member of a holding company.

T F A holding company may keep subsidiaries from receivership in times of financial weakness of the latter.

T F The holding company may be readily regulated by state public service commissions.

T F The chief criticism against holding companies is that they tend to create monopolies which are difficult to regulate.

18. Mark as for question 15.

T F If all the electric light and power companies of this state were subsidiaries of one holding company, the total amount of standby equipment would be less than that required if each utility were an independent company.

- T F Interlocking directorates that exist in some utility holding companies may tend to create a trade monopoly.
- T F The law in this state requires that the books of a public utility holding company be open for inspection by the public.
- T F It is possible to control many millions of dollars worth of property with a relatively small amount of stock by holding-company operation.
- T F The American Telephone and Telegraph Company is a holding company.

CHAPTER IX

INVENTORIES AND APPRAISALS

Inventories may, in general, be divided into two classes: first, those which are taken more or less regularly by a factory or merchandizing organization for the purpose of keeping account of the material and supplies on hand; second, those which are taken as a preliminary step in the appraisal and valuation of property, usually of public utilities.

Both of these classes may be considered briefly as follows:

Merchandise, factory, and many public utility inventories are now made with the assistance of what are known as "perpetual inventories" or by means of regular annual inventories.

The perpetual inventory has many adherents and has been widely used. The method is based upon a very simple principle. If a certain number of articles are on hand at a particular time, a permanent record is made of this number. Additions are made to the record as new articles are added to the stock and subtractions made for those items taken from stock for company use or sale. The result on the record should always show the exact number of all supplies on hand. Where materials are given out only on a written order by a storeroom keeper, this system works very well.

In such cases, prescribed storeroom forms are established for the purpose of accounting for the various classes of supplies on hand while departments and account numbers are necessarily listed upon every requisition to make sure that the articles issued from the storeroom are charged to the proper job order. In the more elaborate systems the initial unit costs and the various shipping, storage, and carrying charges are added to the articles in stock in order that they may be charged to the particular job upon which they are used at a cost representative of all the expense they have incurred up to the time they leave the storeroom.

In plants where it is impossible to keep such an accurate record or where the size of the business does not justify the expense

of such an elaborate system, the annual inventory is usually relied upon. This consists of an actual personal count, as of a certain date, of all the supplies on hand. This actual count usually takes more than a single day, but all additions to or subtractions from the stock after the date selected for the inventory and before the count is completed are eliminated, so that the record actually shows the amount of all articles on hand upon that date. In many plants where this plan is used no shipments are received during the inventory period except on rush or emergency orders.

As a first step in the appraisal or valuation of a plant a complete inventory of its physical property is necessary. This part of the work consumes a relatively large amount of time and in many cases makes up more than half of the total expense of the valuation. However, nothing is more important in making an appraisal that will stand the tests of court inquiry than a complete and accurate inventory. Usually an office inventory is made as the first step in the work. This consists in making, as far as is possible from the office records, an approximate outline inventory of the property. This list is usually very incomplete, but it shows all the different kinds of property owned and makes the work of classification easier. This classification or division of the work is very important.

The actual field work is usually done by groups of workers, each group working on only one class of items at a time, such as foundations, boilers, buildings, etc. The difficult part, and the one in which the office inventory outline helps most, is that of making these divisions so that the different groups will not duplicate material and the work of other groups in the field. For example, if one group is working on machines and another on foundations, the question should be determined in advance as to which group will include the special foundations necessary for these particular machines. These foundations might be considered as part of the machine since their installation and cost were incurred as a result of installing the machine. Again some confusion is likely to occur between the group working on buildings and the group on foundations. It will be seen that a very definite line must be drawn between the assignments of the different groups. In small utilities where one group may make practically the whole inventory, taking one class at a time, this

difficulty is not so apparent, since the members of the group will know pretty well what ground they have previously covered.

FIG. 17.—Inventory form for poles.

	INDIANAPOLIS POWER & LIGHT CO. INDIANAPOLIS, INDIANA		STATE OF INDIANA PUBLIC SERVICE COMMISSION DEPARTMENT OF ENGINEERING					
	UTILITY - LOCATION _____							
	INVENTORY AS OF			APPRAISED AS OF				
ACCT NO.	UNIT	QUANTITY	UNIT PRICE		COST OF RE- PRODUCTION	COND %	COST OF RE- PRODUCTION DEPRECIATED	
<i>This sheet is the form on which the final write-up is made. It also serves as a field inventory sheet for plant equipment, general equipment, etc. as follows:</i>								
GE Co. 25 H.P. motor, 220 volts, 60 cycles, 1170 r.p.m. etc.	ea.	2	200	400				
GE Co. 10 H.P. motor, ditto	ea.	4	100	400				
				800	80	640		
* Allowance made for scrap								
				Total Acct. No.				

FIG. 18.—Inventory form for equipment.

Practically all public service commissions have adopted forms that are to be used by public utilities or the commission employees in their respective states in taking inventories. Under these circumstances the best procedure is to follow the classifications recommended by the commission. Samples of the forms for

field notes as required by the Indiana commission are shown as Figs. 17 and 18.

All field notes should be neatly made and should be of such a nature as to be easily interpreted by the office force at a later date in compiling the data. All field notes and other data applying to the inventory should be carefully preserved. Courts have held that all such data are subject to inspection in case of court procedure involving the results found in the appraisal of which these data form a part. Also the employees who actually took the data are subject to call as witnesses. This fact should be considered in selecting the employees for such work.

After all the field notes are in, the data must be summarized and put into such form that the unit prices may be applied. This work may be carried on to some extent by the office force while the inventory is in progress but it cannot be completed until all the data are in. The actual work of finding the unit prices and applying them to the inventory data will next be considered.

Appraisals.—It is only during the last two decades or so that the making of appraisals has become common. Before this, many of the waterworks, street railways, and other public utilities were privately owned and were operated at the pleasure of the owners with little or no regulation by the state. Stock inventories for accounting, insurance, and other private purposes were often used, but complete valuations of the entire property, for taxes, rate bases, or capitalization ratios were seldom undertaken. Not until some of these utilities were subjected to governmental regulation did valuations and their prerequisite appraisals become common. Most of the pioneer work of appraisal was done in connection with municipally owned waterworks systems, which were among the first utilities to come under public control.

In determining the value of property, it has been and still is considered good practice in many cases to use the net earnings of a business (and its future possibilities) as a basis. For example, a business which earns a net income of \$12,000 a year and which has prospects of continuing a like income or of improving it, would be justified in an appraisal at a figure which, at a fair rate of interest, would return a suitable income. For example, such an income is frequently said to be capitalized as $\$12,000/0.06$ or $\$200,000$. This means that an equivalent investment of

\$200,000 with a 6 per cent return of simple interest will provide the same annual yield of \$12,000 that resulted from this business. Or, by reference to Chaps. XIII and XIV, it will be noted that the present value of an annuity that will pay \$12,000 per annum on a 6 per cent compound interest basis for the next n years is $12,000 \frac{S^n - 1}{S(S - 1)}$, where S is the amount of \$1 at compound interest for one year at a definite interest rate compounded annually while (S^n) is the corresponding amount of one dollar compounded annually for (n) years. This example, figured for 100 years or practically indefinitely, therefore results as follows: Present value of the specified annuity is

$$\begin{aligned} & 12,000 \frac{1.06^{100} - 1}{1.06^{100}(1.06 - 1)} \\ & = 12,000 \times \$16.62 \\ & = \$199,440 \end{aligned}$$

Similarly, if a shorter period of usefulness of such capital is adopted, the capitalization to provide such a yield is

$$12,000 \times \$11.47 = \$137,640 \text{ for twenty years}$$

$$\text{or } 12,000 \times \$7.36 = \$88,320 \text{ on a ten-year basis.}$$

For privately owned concerns, where competition limits the earnings to a fair percentage of profit on the investment, this method is undoubtedly as good as any that has been proposed. But in the case of monopolies, into which class public utilities ordinarily fall, there is no competition and therefore no limit to the earnings of the company except as regulated by commissions. Under these conditions an appraisal on a basis of earning capacity might obviously lead to figures which would have no close relation to the actual value of the property.

Capitalization of corporations, therefore, has not necessarily any definite relation to real value. In a great many cases, owing to ignorance, mismanagement, or apparent necessity, over-capitalization has occurred. In cases where an appraisal is necessary to fix fair rates and earnings, the outstanding securities may have no real significance, although they are usually analyzed by commissions and courts in an attempt to have such securities represent as nearly true values or equities in the business as is possible. The appraisal is of great assistance, therefore, in

determining this relation between capitalization and actual worth or capital of the corporation. This view is aptly stated in the following opinion of the Railroad Securities Commission expressed to the President:

Insofar as the value of the property is an element in rate regulation, the outstanding securities are of so little evidentiary weight that it would probably be of distinct advantage if courts and commissions would disregard them entirely, except as a part of the financial history of the property, and would insist upon direct evidence of the actual money invested and of the present values of the properties. For this and other reasons discussed in the body of the report, your commission recommends that the Interstate Commerce Commission should have authority and adequate funds to make a valuation of the physical property of railroads whenever the question of the present value of these roads is, in the judgment of that commission, of sufficient importance. It is hardly necessary to add that your commission does not believe that the cost of reproduction of the physical properties, however carefully computed, is the sole element to be considered in determining the present value of a railroad, or that the outstanding securities could or should be made to conform to any such arbitrary standard.¹

Subsequent to this recommendation, the railroads have been evaluated.

From the above it will be seen that any appraisal seeking to determine true values for rates, taxes, earnings, etc., must be based upon the actual summing up of all the property, tangible and intangible, by experienced engineers who are absolutely unbiased. Herein lies the really important work of appraisal. The purpose of the engineer is very definite, but so many variables enter into the process that at best the task is a difficult one. The almost endless detail lends itself to error and omissions and, in the end, some provision must be made for them. Prices fluctuate rapidly, and even the methods of arriving at the so-called trend values are so numerous that very often their results fail to check. It has happened many times that engineers, equally experienced in their work and of the greatest integrity, will arrive at widely different results. This has led the public to question the ability and even the integrity of many sincere men and to discount the statements of experts in this line of work. Thus it will be seen that the work must be done as thoroughly and as carefully as time and expense will allow. Usually, the

work of the appraisers must be upheld in court and it becomes necessary for the engineer to be able to give a reason for every step made in the process of appraisal.

Before beginning the actual work there should be clearly in the mind of the engineer the object of the appraisal. There may be one of several things desired. Unless it is clearly understood beforehand just what result is wanted, a large expense may be incurred for something very nearly worthless. Five results may be desired in an appraisal:

1. The investment.
2. The original cost.
3. The cost of reproduction new.
4. The replacement cost.
5. Present value.

Usually only one of these values, defined in Chap. XI, is desired in any one appraisal but that one should be clearly understood by all who have anything to do with the work.

The expense of an appraisal depends largely upon the thoroughness with which it is undertaken. Floy, in his "Valuation of Public Utilities," gives figures ranging from 20 cts. to more than \$1 per \$1,000 of property evaluated, with a figure of 60 to 75 cts. per \$1,000 as a good average.²

In some cases, to be heard before state commissions for the determination of the proper rate base, especially where detailed, accurate appraisals have been made only a few years previously and the perpetual inventories appear to have been adequately maintained, the so-called "horse-back" or "spot" inventory and appraisal may suffice. These involve simply an occasional random check, at various points on the system, or a comparison between the actual physical count and the records of the perpetual inventory. If these check fairly well at random points throughout the property, the earlier inventory may be accepted by mutual consent of all interested parties in order to avoid the expenditure of time and money that would be necessitated in securing greater detailed accuracy. In the case of a less favorable check between the actual physical count and the book values, some predetermined multiplying factor may be agreed upon to be applied to the original inventory, or, in the case of price changes only, the new price index, which is a measure of price ratios between the two dates in question may be applied

TABLE X.—CONSPECTUS OF INDEXES

U. S. averages	Latest	Month ago	Year ago	Last 5 years	
				High	Low
Elec. Sales (Total)	March	Feb.	March	Feb.	March
(Ed. Elec. Inst. Data)	1936	1936	1935	1936	1933
1929 = 100	112.3	113.3	98.8	113.3	79.3
Elec. Rates (Domestic)	March	Feb.	March	Jan.	March
Ave. Rev. per Kw.-hr.	1936	1936	1935	1931	1936
(E.E.I. Data) 1913 = 100	56.7	57.0	60.3	69.0	56.7
Gas Sales (Total)	March	Feb.	March	Feb.	April
(Am. Gas Assoc. Data)	1936	1936	1935	1936	1933
1929 = 100	112.8	121.7	95.6	121.7	79.3
Gas Rates (Domestic)	March	Feb.	March	Feb.	March
Ave. Rev. per M.C.F.	1936	1936	1935	1931	1936
(A.G.A. Data) 1929 = 100	92.6	92.9	95.3	98.9	92.6
Street Railway Traffic	April	March	April	Jan.	Sept.
12 Months' Average	1936	1936	1935	1931	1933
(A.T.A. Data)	74.2	73.9	71.6	89.8	67.5
1926 — 27 = 100					
Street Railway Fares	June	May	June	Jan.	Jan.
(Richey) 1913 = 4.84	1936	1936	1935	1933	1931
	7.83	7.83	7.83	7.90	7.77
Elec. Railway Wages	June	May	June	Jan.	July
(Richey) 1913 = 100	1936	1936	1935	1931	1933
	220.2	220.1	216.2	231.9	201.8
Elec. Railway Materials	May	April	May	Nov.	May
(Richey) 1913 = 100	1936	1936	1935	1935	1933
	131	131	131	132	110
General Construction Cost	June	May	June	June	June
(Eng. News Rec.)	1936	1936	1935	1936	1932
1913 = 100	204.6	203.4	194.8	204.6	152.2
Wholesale Commodities	April	March	April	Dec.	Feb.
(U.S.B.L.S.) 1926 = 100	1936	1936	1935	1935	1933
	79.7	79.6	80.1	80.9	59.8
Cost of Living	May	April	May	Jan.	April
(Nat. Ind. Conf. Bd.)	1936	1936	1935	1931	1933
1928 = 100	84.6	84.3	82.9	91.1	71.5

to the existing quantity items which may have been agreed upon, thereby securing, at minimum expense, a fairly accurate appraisal as of the later date. Table X* illustrates the variation in such cost indexes over corresponding months in previous years based upon the 100 per cent standard at the specific time indicated.³

TABLE XI

Engineering Dept.	Date _____
Public Service Comm.	Made by _____
State of Indiana	Checked by _____
Company and Location _____	

Unit Building Costs

Hauling excavated material in 3 cu. yd. motor trucks, trucks loaded by power excavator, allowing 10 min. to load and get away from excavation, 5 min. to unload and an average travel rate of 8 mi. per hour, which includes delays, waits, etc. Use 8-hr. day. Cost per cubic yard.

Length of haul	Hr. per load	Loads per 8-hr. day	Cu. yd. per 8-hr. day
500 ft.	0.27	29	87
1,000 ft.	0.30	27	81
½ mi.	0.38	21	63
1 mi.	0.50	16	48
1½ mi.	0.62	13	39
2 mi.	0.75	11	33
2½ mi.	0.88	9	27
3 mi.	1.00	8	24
4 mi.	1.25	6	18
5 mi.	1.50	5	15

Note: To find the cost per cubic yard to haul any given distance, divide the cost of truck and driver per day by cubic yards hauled per day.

Truck 8 hr. at \$_____

Foreman 1 hr. at \$_____

Compensation and liability insurance at 3.1 per cent of labor \$_____

\$_____ + _____ cu. yd. = \$_____ per cu. yd.

The first and probably the most important step in making an appraisal is the inventory which has been outlined in the first part of this chapter. After all the data resulting from the inventory are complete, the unit costs should be carefully determined and should include in addition to direct costs as much of the indirect cost as can be correctly allocated to various items

*See also HARDING and CANFIELD, "Legal and Ethical Phases of Engineering," Chap. XI, on Engineering Estimates.

of the inventory such as warehouse overhead, drayage, etc. Table XI indicates the form used by the Indiana Public Service Commission for such costs.

The question of how unit costs are to be determined and what prices are to be used in their calculation is a controversial one. The selection of unit prices or trend costs of supplies is based in part upon the decision as to whether the "original cost" or the "reproduction cost" of the property is to be the basis of this particular valuation. If the former is used, the unit cost price should be determined as accurately as possible from the book records of the company which may indicate the cost at the time the property was constructed. If the reproduction cost is taken as the fundamental principle upon which the appraisal is to be made, the unit cost of reproducing the specific equipment or apparatus "as of the date of the appraisal" is the figure that should be used. Although such a procedure is usually approved for reproduction cost values when applied to relatively large units of equipment such as boilers, turbogenerators, transformers, etc., the controversial problem still remains regarding the unit price to be used for supplies such as copper wire, insulators, poles, etc., whose values may vary widely within a few months' time. For example, it would be obviously unfair to the consumers of a utility company to be required to pay a rate based upon a high valuation as of a date upon which copper wire cost 30 cts. per pound installed, if the plant was constructed during a period of 15-ct. copper and appraised during a subsequent period of depression when copper had again decreased from its maximum price during a period of inflation to approximately 10 to 18 cts. per pound. Conversely, it would be equally unfair to the public utility company to have its rates reduced, because of the temporary low appraisal value due to low-priced copper in the system at the particular time the inventory and appraisal were made. Some form of "trend price" is usually agreed upon, particularly for supplies having variable values, such trend price being the average or weighted average price over a period of from five to ten years previous to the date of appraisal.

Such unit trend prices as have been established and agreed upon may be applied to all the items of the inventory to which such blanket values are found to be appropriate, i.e., certain

TABLE XII

Company _____
Location _____

Date _____ No. _____
Made by _____
Check by _____

WEIGHT OF WIRE PER MILE
Solid Copper

Size	Bare	TBWP
14	66	135
12	104	185
10	166	280
8	263	400
6	419	600
4	666	855
2	1059	1300
1	1335	1620
0	1684	2125
00	2123	2620
000	2677	3330
0000	3376	4000

Stranded Copper

Size	Bare	TBWP
2	1077	1310
1	1363	1650
0	1700	2200
00	2144	2700
000	2709	3355
0000	3305	4225
250 MCM	4026	4950
300 MCM	4831	5840
350 MCM	5636	6900
400 MCM	6442	7950
450 MCM	7274	8700
500 MCM	8052	9700

Aluminum A.C.S.R.

Size	Bare
6	192
4	306
2	486
1	614
0	773
00	974
000	1227
0000	1549

trend prices per pound may be used for a group of copper-wire sizes with specific insulation, another price for larger or smaller group sizes, another for another type of insulation, etc.; one trend price may be applied to all 60-ft. poles, another to 50-ft. poles, etc., unless some radically different quality or top size or butt treatment of a particular group of poles necessitates a modification of the unit figure. All such details of price change must be given very careful consideration if the accuracy capable of withstanding contrast with other competitive appraisals of the same property and the fire of cross-examination upon the witness stand during commission hearing or court appeal is to be established.

After applying the unit costs to the results obtained from the inventory and after making a careful check to avoid errors, an amount is obtained to which the percentages for engineering, contingencies, and administration during construction are added to obtain the "reproduction value" of the physical plant. The definition and function of "reproduction value" are considered in Chap. XI on Process of Valuation.

In order to make any just decision upon such intangible costs, the appraiser must be familiar with the early history of the company. The obstacles encountered in the original development, which might be experienced again if the plant were to be reconstructed, must be considered. Overhead expenses during construction must also be analyzed. Many of these items, which went into the original development, may not be a matter of record and will probably have to be estimated as the result of personal interviews and observations to be made by the appraiser. Working capital, or the money necessary to keep the plant in operation, is another item over which there has been a great deal of controversy, the allowance made depending largely upon the court or commission rulings in that locality. These items, when carefully considered and evaluated, are totalized to obtain the intangible values.

Such intangible values of the property are something which, to the average individual, often seem unjust. Even among experts there is considerable difference of opinion as to how much should be allowed in public utility valuations. Franchises, which are a favorite bone of contention, are often considered as a public concession to the company to permit it to operate its

business and, therefore, such should not be capitalized as part of the property of the company upon which the public must pay a return in the form of higher rates. This view has been upheld in court and seems to be the general trend of court opinion at the present time. However, many cases may be cited where an actual value has been placed upon franchises. These cases usually occur where franchises were granted in earlier days as an inducement to the corporation to locate in a particular town and, as the result, to assume certain responsibilities. Perpetual franchises, which are now rarely granted, are usually considered to have some value. Short-term franchises are sometimes given a value although the tendency is against such a practice. Indeterminate franchises have no value except in cases where it may be shown that actual cash expenditures have been made for such.

Thus, it may be noted in conclusion that the appraisal, strictly speaking, involves the determination of and application of the proper costs to the inventory as an intermediate step looking toward the valuation. Furthermore, since the valuation may be required for one of several possible purposes, each involving a different price analysis, the knowledge, experience, and judgment of the engineer making the appraisal are of very great importance.

Specific References

1. FLOY, HENRY: "Valuation of Public Utility Properties," Report of the Railroad Securities Commission, 1911, p. 2, McGraw-Hill Book Company, Inc., New York.
2. *Ibid.*
3. RICHEY, A. S.: "Conspectus of Indexes," Worcester Polytechnic Institute, Worcester, Mass.

General References

- DONALD, W. J.: "Handbook of Business Administration," McGraw-Hill Book Company, Inc., New York.
- GLAESER, MARTIN G.: "Outlines of Public Utility Economics," The Macmillan Company, New York.
- MARSTON, ANSON, and THOMAS R. AGG: "Engineering Valuation," McGraw-Hill Book Company, Inc., New York.
- MONTGOMERY, R. H.: "Financial Handbook," Ronald Press Company, New York.
- PATOU, W. A.: "Accountants' Handbook," Ronald Press Company, New York.
- REITELL, CHARLES, and CLARENCE VAN SICKLE: "Cost Finding for Engineers," McGraw-Hill Book Company, Inc., New York.

Review Questions

1. Name the two principal purposes for taking an inventory.
2. Distinguish between an inventory and an appraisal.
3. What is a perpetual inventory, how does it operate, and does it abolish completely the necessity of the annual inventory?
4. Outline the procedure in organizing for an inventory of a large utility.
5. Discuss the advantages and disadvantages of the capitalized net earnings as a basis for making an appraisal in the case of (a) a factory; (b) a utility.
6. What is the objective sought in making an appraisal?
7. What is meant by a "spot-check" inventory?
8. Distinguish between cost price, present unit price, and trend price.
9. Under what condition would each of the following be included in an appraisal: (a) franchises; (b) indeterminate permits; (c) option to buy real estate?

CHAPTER X

DEPRECIATION REPLACEMENT AND MAINTENANCE

Depreciation may be simply defined as "the act of lessening the value or worth of property." It is, therefore, a kind of fall in value. It attempts to measure the effect of time and usage upon physical properties and equipment and to record the results in dollars and cents.

Thus measured, it is the difference between the first cost of the property in question and its net salvage value at any particular time of its life.

Depreciation may be postponed but, like taxes, it cannot be avoided. All physical property, excluding land values in growing and popular localities, must suffer and ultimately succumb to depreciation.

Depreciation, broadly interpreted, may be due to: (1) wear and tear, (2) natural action of the elements, such as decay and rusting, (3) obsolescence, (4) lack of utility, or (5) inadequacy.

Illustrations of such types of depreciation are: (1) the wear and tear of an automobile tire, in active use (not stored away), would result in a depreciation approximately proportional to its mileage or usage rather than proportional to time; (2) natural action of the elements produces a depreciation upon a telephone pole which is approximately proportional to time or to the age of the pole; (3) if ball-bearing motors or machines are installed with an economic saving, or if newly designed turboalternators have higher efficiencies or lower water rates, the present machines may be depreciated because of obsolescence, lack of utility, or inadequacy.

Practically all physical property subject to depreciation can be kept, for a certain period, from actual depreciated value by making timely and adequate repairs. A watt-hour meter, so long as it registers within 2 per cent of accuracy, may be considered to have no depreciated value. Hence with small, relatively easily repaired apparatus, adequate repairs, and

maintenance charges, considered as an operating expense, may at least temporarily take the place of a depreciation reserve fund. Such equipment or property may be said to have infinite life. The home of George Washington at Mt. Vernon is a good example of this, as those buildings will be repaired and maintained in their original condition regardless of the economic savings that might otherwise obtain.

To illustrate the procedure in carrying out such maintenance, consider a machine which cost \$11,400 and which involved replacements of worn parts as follows:

	Per Annum
At end of each single year	\$1,000.....
At end of every two years	2,000.....
At end of every three years	3,600.....
At end of every twelve years	4,800.....
	<hr/>
Total annual charge.....	\$3,600

The machine is in 100 per cent of original condition and value at the end of every twelfth year and still has practically infinite life, thus:

TABLE XIII.—DEPRECIATION RESERVE VALUES

Years	Annual debit to depreciation	Annual credit to reserve	Credit balance of reserve	Sound value of machine	Value of machine plus balance in reserve
0	0	0	0	\$11,400	\$11,400
1	\$3,600	\$ 1,000	\$2,600	8,800	11,400
2	3,600	3,000	3,200	8,200	11,400
3	3,600	4,600	2,200	9,200	11,400
4	3,600	3,000	2,800	8,600	11,400
5	3,600	1,000	5,400	6,000	11,400
6	3,600	6,600	2,400	9,000	11,400
7	3,600	1,000	5,000	6,400	11,400
8	3,600	3,000	5,600	5,800	11,400
9	3,600	4,600	4,600	6,800	11,400
10	3,600	3,000	5,200	6,200	11,400
11	3,600	1,000	7,800	3,600	11,400
12	3,600	11,400	.....	11,400	11,400

Thus in the eighth year the depreciated or salvage value of the machine is at its lowest ebb, or \$5,800, which represents about 51 per cent of its original cost; in valuation parlance, it is in "51 per cent condition."

Depreciation due to natural causes may be fairly accurately predetermined from previous experience with equipment of a similar nature, but "functional" causes cannot be predetermined or estimated with any degree of accuracy. Both groups of causes must be taken into consideration in economy studies because there is no clear-cut distinction between them. Economy usually predicts the proper time for the replacement of a piece of equipment, but managerial discretion will often determine the proper time if the cause is purely a functional one. Because of the many indeterminable elements involved in arriving at a depreciation rate in economic problems, the result is, at best, only a reasonable estimate.

Many engineers and economists, particularly railroad officials, have argued that, since the equipment can be kept in satisfactory operation with adequate annual operating and maintenance expenses, there is no need of planning on total replacements, and therefore no depreciation sinking fund need be considered. This is particularly true of railroad right-of-way or pole-line maintenance.

Such an argument would hardly apply, however, to a 208,000-kva. turboalternator such as that in the State Line Power Station of Indiana, which probably cost \$2,000,000 or more. Utility companies are required by state commissions to provide for replacements. Private corporations should and frequently do provide for major replacements at the expiration of the life of large units of equipment by gradually accumulating an adequate depreciation reserve fund from earnings.

It is difficult, therefore, in some manufacturing processes to differentiate between "maintenance" and "replacement of depreciation." It is a good general rule to classify as "maintenance" that expense usable within the year, or some other predetermined period suitable to the particular business in question, and to classify as "replacement" those expenditures for parts and repairs whose life is likely to be greater than one year or one predetermined period. If the maintenance items are excessively large or expensive, the annual operating costs are

abnormal whereas, on the contrary, if replacements are being made without adequate previous provision therefor, they may be unjustly considered as new capital goods and thus fictitiously used to pad the book value of property assets.

Such possible and frequently experienced errors of interpretation of depreciation are well exemplified in the following quotations:¹

Every thousand of brick produced, every case of shoes manufactured, every fashioning of metal and turning of wood, each twist of the handle and blow of the hammer helps to wear out your plant and equipment, and the particular job or process that causes this loss should bear the cost.

Analyze the cost of almost any group of manufacturers marketing the same product and you will detect two kinds of differences: one real, the other accidental. Real differences in cost arise from superior management, higher productivity, and better disposition and utilization of capital, etc. Such differences are the very breath and life of business.

The accidental differences are due to the failure on the part of manufacturers to include all the proper and legitimate items of expense in costs, and improper distribution of overhead, etc., and differences of this nature make for business unsettlement. One such accidental difference in costs most frequently found arises where manufacturers do not charge depreciation at all or leave depreciation to be dealt with at the end of the year.

The businessman who does not charge depreciation at all is fooling himself. He is making no provision for the inevitable day when his property must be scrapped. His supposed profits may be, in fact, a distribution of his capital.

The businessman who waits until the end of the year to determine his depreciation according to the size of his profits may make the discovery that he has no profits, since he has consistently sold his product upon a cost that was incorrect—a cost that did not include such a necessary expense of manufacture as depreciation.

The competition of the future should be an informed competition. The basis of lower prices must be a greater efficiency, not incomplete costs. To that end, *everything that goes through your factory should bear its proportional cost of depreciation. Charge depreciation into current costs.*

The need of depreciation arises from the fact that working assets gradually give out or become obsolete. They are, in fact, used up in production.

Were the assets consumed in any one year, their entire cost would be written off during that year, but the process of depreciation is slow,

usually extending over a period of years. Hence it is unfair to charge off all the cost in any one year.

It is frequently declared that the moment a machine or piece of equipment enters a plant it becomes secondhand and at once loses a considerable share of the original cost, and it is asserted that this loss of value should be reflected on the books by a sizable first charge for depreciation. But we are not concerned primarily with what property will bring, its resale value, but how property is used up. *The test for depreciation is how long the property will function, or how many units it will produce before scrapping time.* Just as the meter notes the flow of current, so depreciation seeks to register in costs the gradual loss of usefulness of plant and equipment.

This loss of usefulness is an incident of time and service and is unaffected by the rise or fall of prices or the possible loss in resale value after purchase.

Thus it is seen that some recognition and estimates of depreciation are absolutely necessary for successful and economical business operation. To this end the executives of private business direct their administrative policies and their accounting practices while state-regulated public utilities are required by their respective state commissions to set up adequate depreciation reserves for replacements and thereby avoid overvaluation of their capital assets.

The estimates of such adequate depreciation and particularly their allocation to specific subdivisions of plant equipment are complex and difficult. They are obviously not without considerable error. Recognition of their shortcomings, however, does not warrant their abandonment. There is too great a tendency to use rule-of-thumb percentages and composite blanket reserves to cover a multitude of items of depreciation rather than to analyze each group of property values having similar characteristics of deterioration. A guess cannot be justified. An engineering estimate of depreciation takes into consideration all the factors governing a given tendency to depreciation, assigns varying degrees of importance and weighted values to each, relies upon inspection and past experience with similar property, differentiates between the various types of equipment and their probable rates of depreciation, and applies individual or allocated depreciation methods and values to each group made up of similar units.

Tables indicating the probable life and the resultant depreciation of various types of buildings and equipment are now available; these have been gradually built up from various group experiences and comparisons and are much more dependable than the blanket percentages frequently used for such a purpose.^{2,3}

Three methods of estimating adequate depreciation values for relatively large items of long-lived equipment and for the provision of sufficient reserve funds for the replacement of greatly depreciated or obsolete equipment are in general use, and a fourth and more exact method is sometimes prescribed in principle if not applied in all its detail. These methods are:

1. Straight line.
2. Sinking fund at prescribed interest rate.
3. "Matheson" or constant-ratio method.
4. "Gillette" or unit-production cost method.

In order to contrast and determine the proper application of each of these methods, the general case will be set up and the concrete application made thereafter to the same assumed conditions:

In all cases the nomenclature is as follows:

Let C = first cost of equipment.

A = age in years for any desired calculation of values.

L = estimated life of equipment, after which time complete replacement is necessary.

C_L = salvage value at end of estimated life of L years.

C_A = value at age A years.

$C - C_A$ = depreciation up to age of A years.

These relations are shown graphically in Fig. 19.

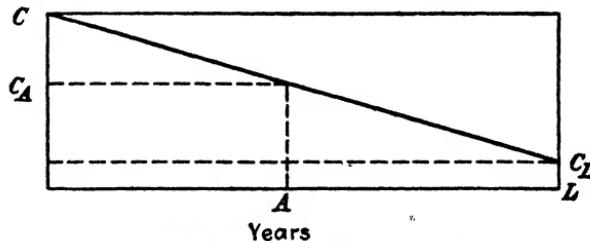


FIG. 19.—Graphical representation of the relation between C , C_A , and C_L .

Straight-line Method.—In the straight-line method the value $(C - C_L)$ is distributed equally over L years and the amount $(C - C_L)/L$ is the depreciation per annum or

$$C_A = C - A \frac{C - C_L}{L}$$

The amount in such a fund at any age A years is

$$C - C_A = A \frac{C - C_L}{L}$$

Thus a \$22,000 property which depreciated \$8,000 in eight years with a \$2,000 salvage value at the end of its life would depreciate \$1,000 per annum as in Fig. 20.

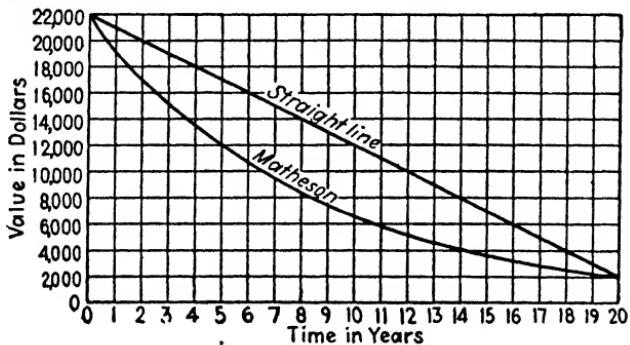


FIG. 20.—Salvage value of a \$22,000 property by the straight-line and Matheson methods.

Sinking-fund Method.—This has been calculated between the same limits for simplicity of illustration. It has correspond-

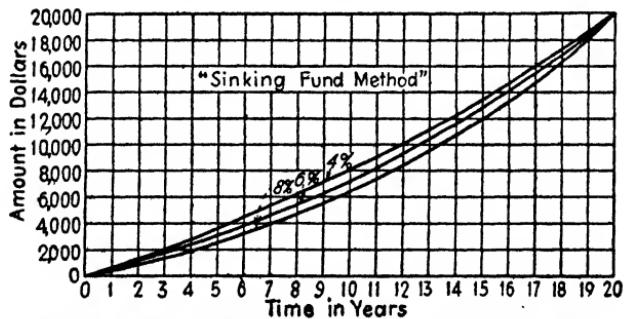


Fig. 21.—Depreciation of a \$22,000 property by the sinking-fund method. ingly lower intermediate values in the fund as the interest rate is increased.

Thus this same problem would provide by the sinking-fund method (Fig. 21):*

* See Chaps. XIII and XIV for development and application of sinking-fund factors.

At 4 per cent interest:

$$\text{To provide } \$20,000 \text{ in 20 years} = D \frac{S - 1}{S^n - 1} = \$20,000 \times 0.0336$$

$$D \times \text{Table XXIV} = \$672 \text{ per annum.}$$

At the end of eight years there would be in the fund:

$$\text{Amount} = D \frac{S^n - 1}{S - 1} = \$672 \times 9.214 = D \times \text{Table XXIII} = \$6,192$$

At 8 per cent interest:

$$\text{Table XXIV gives } \$20,000 \times 0.0218 = \$436 \text{ per annum}$$

$$\text{and Table XXIII gives an amount} = \$436 \times 10.64 = \$4,639.$$

Matheson Method.—The Matheson method assumes that the property depreciates at a “constant percentage” rate each year, but that such depreciation rate is applied to the depreciated value at the beginning of any one year.

Thus, if k is the constant annual percentage rate of depreciation:

$$\begin{aligned} \text{Actual depreciation first year} &= kC \\ \text{Depreciated value at end of first year} &= C - kC = C(1 - k) \\ \text{Depreciation second year} &= kC(1 - k) \\ \text{Depreciated value at end of second year} &= C - kC - kC(1 - k) \\ &= C - kC - kC + Ck^2 \\ &= C(1 - k)^2 \end{aligned}$$

Thus, in general:

$$\text{Depreciated value at end of } A \text{ years } C_A = C(1 - k)^A$$

or $\frac{(C_A)^{\frac{1}{A}}}{C} = (1 - k)$, whence $k = 1 - \frac{(C_A)^{\frac{1}{A}}}{C}$. But since k is the same every year, it is true for L years or

$$k = 1 - \frac{(C_L)^{\frac{1}{L}}}{C} \quad \text{or} \quad 1 - k = \frac{(C_L)^{\frac{1}{L}}}{C}$$

or

$$\log(1 - k) = \frac{\log C_L - \log C}{L}$$

from which k may be determined or, more directly,

$$C_A = C \left[1 - 1 + \frac{(C_L)^{\frac{1}{L}}}{C} \right]^A = C \frac{(C_L)^{\frac{A}{L}}}{C}$$

Such values of C_A will fall more rapidly during the early years than the straight-line law. Thus for the case in question:

$$C_8 = \$22,000 \left(\frac{\$2,000}{\$22,000} \right)^{\frac{1}{20}} = \$22,000(0.0909)^{0.05}$$

$$0.4 \log 0.0909 = 3.5834 - 4$$

$$\log^{-1} 3.5834 - 4 = 0.3832$$

$$C_8 = \$22,000 \times 0.3832 = \$8,430$$

See previous chart (Fig. 20) for C_8 and trend curve.

Building Depreciation Reserves and Amortization.—“Amortization is the process of reducing a debt by means of a sinking fund.

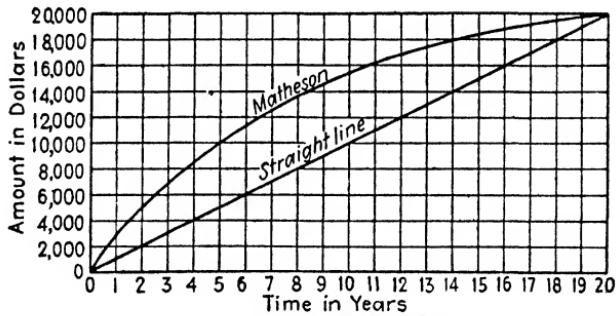


FIG. 22.—Depreciation of a \$22,000 property.

“When the accountant assumes a life for a certain piece of property, he charges a fixed per cent per year, in order to return to the capital account the value of the property. He is not charging off depreciation, but is charging off amortization. These two words are synonymous only in special cases, where the estimated life, made when the property was purchased, proves later to be the correct actual life when the property is junked.”

When providing funds for the replacement of depreciated or obsolescent equipment, it is desired to approximate with such a fund the actual depreciation as closely as possible. The chart (Fig. 20) is therefore most conveniently reversed and the $(C - C_A)$ values are approximated as in Fig. 22.

Thus in the straight-line method the fund contains at age of eight years:

$$\$22,000 - \$14,000 = \$8,000.$$

With the Matheson method we would have

$$C - C_A = \$22,000 - \$5,024 = \$14,976$$

in the fund at the end of eight years. This provides an ample amount but is rather severe on a small company in the early years.

The importance of selecting one of these methods of providing a depreciation reserve and of consistently adhering to such a policy in the accounting system is forcefully set forth in the following warning issued by the Indiana Public Service Commission:

Frequently a utility will fail to maintain a depreciation fund and while permitting its original property to depreciate will make extensions or additions out of so-called surplus income and then seek to capitalize their extensions and improvements, when the moneys so expended should have been set aside as a depreciation reserve, which legally is not susceptible of capitalization. This practice by utilities of setting up a fictitious book depreciation and ignoring proper depreciation debits against this account can only result in the commission taking such steps as will effectuate a complete and substantial obedience to the specific depreciation provisions of the act. In cases where the practice has continued, the commission will naturally, for rate-making purposes, make such deductions from operating expenses as may be found proper and sufficient to cover a reasonable depreciation reserve.⁵

Reviewing briefly the various methods of taking care of depreciation for a power plant having an original value of \$220,000 and an ultimate salvage value of \$20,000, the depreciable amount of \$200,000 may be provided during a twenty-year life as follows:

Straight-line method:

$$\frac{\$200,000}{20 \text{ years}} \text{ or } \$10,000 \text{ per year}$$

Depreciation at end of 10 years = $10 \times \$10,000 = \$100,000$

Depreciated or salvage value at age 10 = $\$220,000 - \$100,000 = \$120,000$

Sinking-fund method (6 per cent):

$$\text{Deposit factor (Table XXIV)} = \frac{S - 1}{S^n - 1} = \frac{1.06 - 1}{1.06^{20} - 1} = 0.0272$$

$$\text{Annual deposit} = \$200,000 \times 0.0272 = \$5,440$$

$$\text{Table XXIII factor} = \frac{S^{10} - 1}{S - 1} = \frac{1.06^{10} - 1}{0.06} = 13.18$$

$$\text{Depreciation at 10 years} = \$5,440 \times 13.18 = \$71,700$$

$$C_{10} = \$220,000 - \$71,700 = \$148,300$$

Sinking-fund method (4 per cent):

$$\text{Table XXIV} = 0.0336 \times \$200,000 = \$6,720 \text{ per annum}$$

$$\text{Table XXIII} = 12.01 \times \$6,720 = \$80,700 \text{ in 10 years}$$

$$C_{10} = \$220,000 - \$80,700 = \$139,300 \text{ (value at end of 10 years)}$$

Sinking-fund method (8 per cent):

$$\text{Table XXIV} = 0.0219 \times \$200,000 = \$4,380 \text{ per annum}$$

$$\text{Table XXIII} = 14.49 \times \$4,380 = \$63,510 \text{ in 10 years}$$

$$C_{10} = \$220,000 - \$63,510 = \$156,490 \text{ (value at end of 10 years)}$$

Matheson method:

$$C_A = C \left(\frac{C_L}{C} \right)^{\frac{A}{L}} = \$220,000 \left(\frac{\$20,000}{\$220,000} \right)^{\frac{10}{20}} = \$220,000 \times 0.0909^{0.5}$$

$$= \$220,000 \times 0.3018 = \$66,400 \text{ salvage value}$$

$$\text{Depreciation} = \$220,000 - \$66,400 = \$153,600$$

None of these methods takes into consideration operation and maintenance expense and yet it is generally recognized that, if maintenance expense is at least adequate and repairs are made at the proper time, the actual physical wearing depreciation of equipment will be less.

Usually the annual operating and maintenance expenses for adequate service will increase as the equipment grows older. Some methods of determining salvage value at a given age, therefore, have been made to include the effect of increasing or at least changing operating and maintenance charges.

Gillette Method.—This method, credited to Mr. Gillette, a prominent consulting engineer, is based upon the following principle:

"The owner of a secondhand machine (or structure) is entitled to such a price for it as will enable the purchaser to go on with its

use and produce each unit of product at as low a cost as the average unit cost of production would be during the entire life of the machine.¹¹

This obviously takes into consideration (1) interest and other fixed charges, (2) operation cost and maintenance cost as well as the quantity production made possible.

Thus

$$V_L = \frac{(C - C_L)d_L + Cr + O_L + M_L}{U_L}$$

for the entire life of L years is equated to

$$V_{L-A} = \frac{(C_A - C_L)d_{L-A} + C_A r c_A + O_{L-A} + M_{L-A}}{U_{L-A}}$$

for the $L - A$ remaining years of life, or

$$C_A = \frac{U_{L-A}[(C - C_L)d_L + Cr + O_L + M_L] + C_L d_{L-A} - (O_{L-A} + M_{L-A})}{d_{L-A} + r c_A}$$

In these equations the following nomenclature has been used corresponding to that of previous methods:

V_L = unit cost of service during life of L years.

V_{L-A} = unit cost of service during last $L - A$ years of life.

A = age in years for which salvage value is sought.

d_L = annual deposit to provide \$1 in L years from Table XXIV.

d_{L-A} = annual deposit to provide \$1 in $L - A$ years from Table XXIV.

M_L = annual cost of maintenance for L years.

M_{L-A} = annual cost of maintenance for $L - A$ years.

O_L = annual operating cost for L years.

O_{L-A} = annual operating cost for $L - A$ years.

r_c = ratio of interest and other fixed charges to C .

r_{c_A} = ratio of interest and other fixed charges to C_A .

U_L = annual output during life of L years.

U_{L-A} = annual output during period of $L - A$ years.

As an illustration of this method applied to the power station previously considered, the following additional values are taken from operating reports of the company:

Rating of station = 1500 kw. (\$146.50 per kw.)

Station factor* = 20 per cent average for first 20 years.

Station factor* = 22 per cent during later 10 years = ($L - A$)

Interest rate on sinking fund (throughout life) = 6 per cent.

Fixed charges exclusive of depreciation (throughout life) = 9 per cent.

O_L , average operating expenses per annum (20 years) = \$12,000

O_{L-A} , average operating expenses per annum (last 10 years) = \$13,800 (increase 15 per cent)

M_L , average maintenance expenses per annum (20 years) = \$15,000.

M_{L-A} , average maintenance expenses per annum (last 10 years) = \$17,250 (increase 15 per cent)

Annual output = $1500 \times 0.20 \times 365 \times 24 = 2,628,000$ kw.-hr.
(20 years)

$$O_L + M_L = \$27,000 \text{ or } \frac{\$27,000}{2,628,000} = 1.027 \text{ cts. per kw.-hr.}$$

Annual output = $1500 \times 0.22 \times 365 \times 24 = 2,890,000$ kw.-hr.
(last 10 years)

$$(O + M)_{L-A} = \$31,050 \text{ or } \frac{\$31,050}{2,890,000} = 1.074 \text{ cts. per kw.-hr.}$$

$$\text{Ratio } \frac{U_{L-A}}{U} = 1.1$$

$$C_{10} =$$

$$\frac{1.1 \times [200,000 \times 0.0272\ddagger + 220,000 \times 0.09 + 12,000 + 15,000]}{0.0759 + 0.09}$$

$$+ \frac{20,000 \times 0.0759\ddagger - (13,800 + 17,250)}{0.0759 + 0.09}$$

$$= \frac{1.1 \times [5,440 + 19,800 + 27,000] + 1,518 - 31,050}{0.1659}$$

$$= \frac{1.1 \times [52,240] + 1,518 - 31,050}{0.1659} = \frac{27,932}{0.1659} = \$168,400$$

Depreciation to 10th year = \$220,000 - 168,400 = \$51,600

* Defined as the ratio of the actual average output to the rated possible output of the station.

† Table XXIV 6 per cent, 20 years.

‡ Table XXIV 6 per cent, 10 years.

Note that this is less than sinking-fund values at either 6 or 8 per cent interest.

It should be noted further that, as the operation and maintenance expenses during the $L - A$ years increase in greater proportion to the output, the salvage value decreases and the depreciation increases. This condition, i.e., salvage values decreasing and depreciation rates increasing, tends either to hold fixed charges constant or actually to reduce them while the operation and maintenance costs are mounting upward.

Usually the output under these conditions will not keep pace with the increase of operating expenses and maintenance but may actually decrease. For example, Mr. Sanford of the Detroit Edison Company reports an increase of 0.16 lb. of steam per kilowatt-hour over an average period of 5.7 years for their steam turbines, which corresponds to an annual increase of 1.2 per cent of the guaranteed steam rate.⁷

Thus with fixed charges constant or decreasing and operating and maintenance charges increasing with increased age of equipment, the total annual cost will reach a minimum value at some intermediate age, at which time the equipment should be replaced.

Thus four possible methods of calculating depreciated values and desirable depreciation reserves have been outlined, Table XIV and Fig. 23. The selection of the one most applicable to the particular business and type of property is the problem of the executive as advised by his engineers and accountants.

TABLE XIV.—COMPARISON OF DEPRECIATION AND SALVAGE VALUES BY ALL FOUR METHODS

	Depreciation	Salvage value
Straight line.....	\$100,000	\$120,000
Sinking fund (4 per cent).....	80,600	139,400
Sinking fund (6 per cent).....	71,000	149,000
Sinking fund (8 per cent).....	63,500	156,500
Matheson method.....	153,600	66,400
Gillette method.....	51,600	168,400

If complete inventories and valuations have been made as explained in Chaps. IX and XI and if, by means of a perpetual

inventory, such values have been kept up-to-date, frequent and fairly accurate checks can be made of depreciated values and the corresponding depreciation reserves. Generally speaking, the sum of these two values, for any large item of property or for the business as a whole, should compare favorably with the true original value carried on the books for the item in question or for the entire business, respectively.

For suggestions regarding suitable methods of accounting for accrued depreciation and depreciated values, the reader is referred to Chap. IX on Inventories and Chaps. XIV, XVI, and

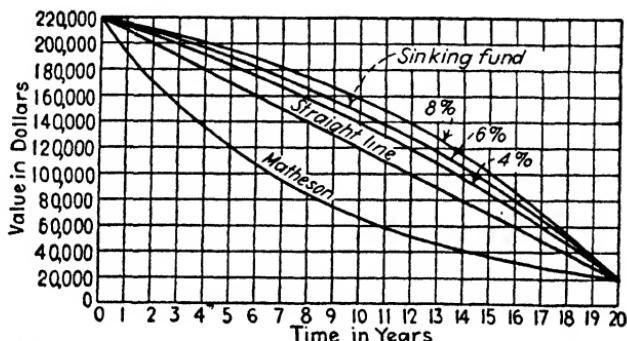


FIG. 23.—Comparison of salvage values by the four methods.

XXVI on accounting. However, the question of whether a single piece of equipment is to be depreciated individually, as one of a group of several similar units, or in the form of a weighted composite average is one of policy to be determined by the management.

If a weighted composite average is to be decided upon, in the interests of simplicity of accounting but at the expense of accuracy, a method of arriving at a proper and dependable percentage to be charged annually to a depreciation reserve for the composite property may be illustrated most readily by means of the following problem:

Suppose the principal items of equipment in a large power station consist of three turbogenerators, each with an estimated life of twenty years, six boilers with a probable life of fifteen years, and a switchboard which is good for twenty-five years. A composite depreciation table for all equipment, using the straight-line method, would be:

TABLE XV.—COMPOSITE WEIGHTED DEPRECIATION

Items	Original cost	Estimate life, years	Depreciation per annum, per cent	Actual depreciation per annum
3 turbogenerators.....	\$300,000	20	5.0	\$15,000
6 boilers.....	250,000	15	6.66	16,666
Switchboard.....	15,000	25	4	600
Total (weighted).....	\$565,000	17.5	5.7	\$32,266

Whereas, in the case outlined above, a depreciation reserve of 5.7 per cent of the original cost of all the equipment is set aside each year, it is probable that adequate funds will be available for replacements where needed; yet the condition of the equipment should be checked from year to year and the rate adjusted thereby. Furthermore, engineering judgment must be exercised in assigning different depreciation rates to the various portions of a composite plant. The question should be asked, for example, whether this particular switchboard is likely to have any value at all during the five years of estimated life after the turbo-alternator is worn out or whether the turboalternators will be available with *new boilers* during the last five years of the estimated excess of life of the former. In several instances reliable engineers have been known to rate buildings and machine foundations with very long lives and resultant low depreciation rates when as a matter of fact they would be of no value after the particular dependent short-lived machinery was worn out.

Thus again, in this discussion of depreciation, the conclusion is endorsed that engineering experience and the mature judgment that such experience develops are of paramount value, not only for the successful operating engineer, but for the executive of both public utility and manufacturing industries.

Specific References

1. "Depreciation Treatment in Production Costs," pamphlet, Department of Manufacture, Chamber of Commerce of the United States, 1927.
2. "Standard Handbook for Electrical Engineers," 6th ed., Sec. 13, p. 56, McGraw-Hill Book Company, Inc., New York.
3. "Financial Handbook," p. 156, Ronald Press Company, New York.

4. HAYNES, JUSTIN H.: "Some Phases of Depreciation and Amorization," *Elec. World*, June 22, 1929.
5. *Nat. Elec. Light Assoc. Bull.*, March, 1918.
6. FISH, J. C. L.: "Engineering Economics," McGraw-Hill Book Company, Inc., New York; H. P. GILLETTE: "Handbook of Cost Data," Gillette Publishing Company, New York; H. P. GILLETTE: "Handbook of Construction Costs," Gillette Publishing Company, New York.
7. LOVELL, A. H.: "Generating Stations," p. 97, McGraw-Hill Book Company, Inc., New York.

General Reference

MARSTON, ANSON, and THOMAS R. AGG: "Engineering Valuation," McGraw-Hill Book Company, Inc., New York.

Review Questions

1. Show by a set of curves the difference between the straight-line, sinking-fund, and Matheson methods of determining depreciation. Indicate which ordinate of each curve is depreciation as contrasted with salvage value.
2. If C = first cost, C_L = scrap value, C_A = salvage value, L = years of life, A = any number of years less than L years, F_A = amount in the fund at A years, D_L = yearly deposit to create a fund in L years, d_L = Table XXIV factor for L years, f_A = Table XXIII factor for A years, and D = depreciation, derive general expressions for D , C_A , and F_A for the straight-line, sinking-fund, and Matheson methods of depreciation.
3. What are the various reasons why a machine is worth less after it has been used for 10 years?
4. A \$45,000 alternator is estimated to have a life of 20 years and a scrap value of \$5,000. Fill in the following table.

	Straight line	Sinking fund (6 per cent)	Matheson
Annual deposit			No common value
C_A for $A = 10$			
F_A for $A = 10$			

5. What will be the depreciation in 10 years on an alternator, having a life of 30 years and a first cost of \$100,000, by the sinking-fund method (5 per cent) and by the Matheson method? Scrap value is \$1,000.
6. Determine the depreciation and salvage value at the end of 8 years of a machine which costs \$50,000 and which is estimated to have a junk value of \$5,000 at the end of 12 years, if 6 per cent annual compound interest is available, by (a) straight-line method; (b) sinking-fund method.

7. A 300-ton electric locomotive cost \$150,000 and was estimated to have a life of 20 years and a scrap value of \$6,000. On this basis, depreciation reserves were figured. However, at the end of 10 years the management is considering the replacement of this locomotive with a new one costing \$200,000. The old locomotive can be sold to a coal mine for \$20,000. If the amount in the depreciation reserve and the selling price of the old locomotive may both be applied on the new engine, what additional sum must be appropriated if:

- a. A 4 per cent sinking fund had been used for a depreciation reserve?
- b. The constant percentage of diminishing return (Matheson) method had been used?

8. Ten years ago a \$100,000 substation was built with an estimated life of 20 years and a scrap value of \$10,000. Because of unforeseen circumstances this substation must be abandoned 10 years later and a new one built costing \$80,000. The old building and site can be disposed of for \$6,000. Compare the make-up required for each of the following types of depreciation reserves: (a) straight line; (b) 5 per cent sinking fund; (c) Matheson method.

9. On Jan. 1, a \$50,000 rotary converter was purchased by the A.B.C. Electric Co. At that time the converter was estimated to have a life of 15 years and a scrap value of \$5,000. A 5 per cent sinking fund was established to take care of the depreciation. Ten years later a new management is considering replacing the rotary converter with a mercury-arc rectifier. They find they can dispose of the old machine for \$10,000 cash and that a new rectifier of suitable capacity will cost \$37,500.

- a. What additional money, if any, will have to be raised exclusive of depreciation and selling price to purchase the rectifier?
- b. Repeat (a) if the depreciation reserve had been accumulated by the Matheson or constant percentage method.

10. A \$10,500 truck has an estimated life of 6 years and a scrap value of \$500. At the end of three years it is wrecked so badly that the remains are worth only \$200. How much money would have to be raised to purchase a new bus of the same first cost if a depreciation reserve had been maintained by (a) straight-line method; (b) sinking-fund method at 5 per cent annual compound interest; (c) constant percentage of diminishing-return method.

11. An autobus which costs \$15,000 and whose life was estimated at 8 years was depreciated in accordance with the Matheson method, assuming a scrap value at the end of its life of \$500. At the end of 5 years the bus was replaced by another of the same first cost, scrap value, and estimated life. A sinking fund was then established to provide for the depreciation of the new bus, but on a 5 per cent basis.

- a. Indicate approximately the graph of salvage value through each of the first 8 years of operation.
- b. How much cash had to be supplied at the end of the fifth year?
- c. What was the salvage value of the second bus at the age of 3 years (i.e., 8 years after the company was started)?

12. Calculate by the Matheson method the salvage value of equipment having a first cost of \$100,000, a scrap value of \$5,000, an age of 12 years, and a life of 20 years.

13. A storage battery which costs \$10,000, with no ultimate salvage, is estimated to have a life of 10 years. What is its estimated salvage value at the end of 8 years. (a) by the straight-line method; (b) by the 5 per cent sinking-fund method; (c) by the Matheson method?

14. Determine the amount that would be accumulated in the following 20-year life funds at the end of 18 years when calculated with a first cost of \$200,000 and a scrap value of \$5,000:

- a. 7 per cent sinking fund.
- b. Matheson fund.
- c. What is the constant annual percentage ratio necessary to provide for the Matheson fund?

15. Newly developed and special equipment is purchased for \$20,000. The engineers are afraid of obsolescence and decide to depreciate the equipment by the Matheson method. They estimate the life to be 10 years and the scrap value to be \$1,000. At the end of 5 years they find that new and improved equipment can be purchased for \$18,000 and that the old equipment can be sold to a municipal plant for \$5,000. Was the original estimate conservative and what was the margin of safety in dollars?

16. Ten years ago a \$12,000 special machine was purchased. It was estimated to have a life of 10 years and a scrap value of \$2,000. Depreciation was maintained on this equipment by the Matheson method for 5 years. At that time economic pressure forced the company to abandon the first plan and to depreciate the remaining value in the machine by the 5 per cent sinking-fund method. What was the annual payment during the last 5 years?

17. Ten years ago Company A purchased a turboalternator that cost \$55,000. At the time of purchase the company's engineers estimated that the machine would have a life of 15 years and a net scrap value of \$5,000. A depreciation fund was set up on this basis by the Matheson method.

- a. What price would have to be obtained from a secondhand buyer at this time to enable Company A to replace this machine without loss if the new machine costs \$50,000 and the expense of removing the old machine is \$2,000?
- b. Repeat (a) if the depreciation fund had been created by the 5 per cent sinking-fund method instead of the Matheson method.

18. A machine was purchased 5 years ago for \$10,000. It was estimated to have a life of 10 years and a scrap value of \$1,000. On this basis depreciation was figured by the Matheson formula. Operating expenses are \$3,000 a year, repairs and maintenance are \$200 a year, and fixed charges exclusive of depreciation are 8 per cent of original investment. At the present time a study is being made to determine whether to continue the use of the old machine, but depreciated from now on by the straight-line method, or to purchase a new type of machine costing \$12,000. The present salvage value of the old machine may be applied toward the purchase of the new one. This machine is estimated to have a life of 10 years and a scrap value of \$2,000. Because of its construction, depreciation more nearly follows the 5 per cent sinking-fund method. Operating expenses are \$2,000 a year, repairs and maintenance are \$300, and fixed charges exclusive of depreciation

are 8 per cent of the new investment. Would you recommend a change and why?

19. Place a circle around the letter T or F in front of the following statements according to whether you consider each of them to be true or false, respectively:

- T F Decreasing the depreciation reserve will improve the operating ratio.
- T F Obsolescence may involve greater reductions in physical values than natural depreciation.
- T F The sinking-fund method of depreciation payments provides larger amounts in the early years than the straight-line method.
- T F The constant percentage method of setting aside a depreciation reserve provides the largest salvage value of all methods during intermediate years.
- T F A sinking-fund method of providing for depreciation involves larger salvage values during intermediate years than a straight-line depreciation policy.
- T F Replacement of equipment is always the result of natural wear and tear during its operation.
- T F The Matheson method is preferable where there is danger of early obsolescence.
- T F The straight-line method is never justified when money is available for employing the Matheson method.
- T F An automobile is a good example of the kind of depreciation best covered by the Matheson method.
- T F A storage battery is a good example of the kind of depreciation best covered by the sinking-fund method.

CHAPTER XI

THE PROCESS OF VALUATION

Valuation, considered as an act, is the "art of valuing or of determining values."

Value, although variously interpreted for certain specific purposes, is defined by the Century Dictionary as "the importance of a commodity measured by the amount of other commodities (commonly represented by money) for which it can be exchanged in the open market, or the price equivalent to its intrinsic worth, which shall be a real equivalent."

Corporate property, particularly that of public utilities subject to commission and court regulation, may be evaluated for purposes of:

1. Establishing a rate base.
2. Sale or consolidation.
3. Taxation.
4. Insurance determination.
5. Bond-issue determination.
6. Comparison with capitalization.

Although it is generally recognized that these values, derived for the various purposes indicated, do not necessarily coincide with one another, those listed near the top of this group, in particular, must be very accurately determined. Probably the valuation for the purpose of establishing a rate base is the most important and is usually subjected to the most exacting scrutiny and cross-examination before regulatory commissions and courts. This will be discussed in more detail in Chap. XXIX.

While it would seem highly desirable and economically sound to have a valuation common to all applications, it is out of the question, at the present time, in many states to propose the same valuation for all the purposes listed above. Values for purposes of taxation, sale, or rate base are therefore recognized, even by the courts, as being legitimately different; frequently executives and accountants have appeared on the witness stand before a tax commission and upon closely consecutive occasions before a

public utility regulatory commission and have claimed, with the approval of the court, two varying values for the same property.

The Supreme Court of the United States, however, has ruled: "The ascertainment of that value is not controlled by artificial rules. It is not a matter of formulas, but there must be a reasonable judgment having its basis in a proper consideration of all relevant facts."¹

In other words, after the most exact inventories of property and schedules of unit prices have been made, the engineer must use experienced judgment in determining the summarized final valuation and must be prepared to support such a decision in his court testimony.

Such a valuation is a much broader term than is implied by the inventory and appraisal of physical property alone, for it may, in some cases, involve many so-called intangible values not definitely resident in physical property. The particular company under consideration may have actually purchased and paid for certain franchises, easements, right of ways, etc.; or it may have expended considerable sums of money in piecemeal construction or in building up a healthy successful business, rendering thereby excellent service at the expense of earlier stockholders who may have received little or no return upon their investment. In some instances such so-called intangible values of a "going concern" have been given recognition as a part of the value in a valuation.

Any valuation, therefore, which is finally determined upon by the commission as a basis for any of the purposes listed above must be established as the result of a careful analysis of each specific utility corporation, including its past history, its local environment, its annual reports based upon a standardized accounting system, and its original and subsequent book values, if available, as well as the present values, tangible and intangible, which may result from the present-day inventory and appraisal.

With these auxiliary values in mind, the main item of the valuation, i.e., the physical "value of property used and useful for the public," should first be determined. The question immediately arises as to which of the following possible values shall be selected or, if more than one may be legitimately considered, what ratio or weight shall be attached to each of the values that are recognized to be at least partially pertinent to the problem.

1. Original cost plus improvements.

2. Present book value.
3. Replacement value as of date of appraisal.
4. Reproduction value as of date of appraisal.
5. Present value as of date of appraisal considered as reproduction value less depreciation.

Each of these valuations has its advocates, and volumes have been written during the last two decades in support of each. A brief summary of most of the important advantages and disadvantages of each of these methods is outlined and many references are quoted for their support.

Original Cost Plus Improvements.—It would seem upon first consideration that, if the corporation has a record of its original investment in the property, which is frequently not available, if it has been adequately maintained and timely replacements have been made with corresponding records, and if the improvements have been properly and accurately recorded from time to time, the "original cost plus improvements" would be a very fair and dependable basis for a valuation.

The advantages of this method may be listed as:

1. Return to investors should be made upon their actual investment because "the thing devoted by the investor to the public use is not specific property, tangible and intangible, but *capital* embarked in an enterprise. Upon the capital so invested the federal Constitution guarantees to the utility the opportunity to earn a fair return."²
2. It is a measure of their sacrifice or risk.
3. It is a definite fact, not a visionary estimate.
4. If it is necessary to approximate or estimate, it should be more accurately estimated than an application to a hypothetical case.
5. "Prudent investment must be considered as prudent at the time it was made; must assume reasonable judgment was used unless proven to the contrary."³

Prudent investment would be ascertained as a fact, not determined as a matter of opinion. It would not fluctuate with the market price of labor, of materials or money. It would not change with the hard times or shifting populations. It would not be distorted by the fickle and varying judgment of appraisers, commissions, or courts. It would, when once made in respect to any utility, be fixed for all time, subject only to increases to represent additions to plant, after allowance for the

depreciation included in the annual operating charges. The wild uncertainties of the present method of fixing the rate base under the so-called rule of Smyth and Ames would be avoided;² and likewise the fluctuations which introduce into the enterprise unnecessary elements of speculation, create useless expense, and impose upon the public a heavy, unnecessary burden.⁴

6. Once determined, it may be kept up-to-date. It is the only method, therefore, which can be kept by accurate accounting principles.

7. Does not fluctuate with market prices of labor, materials, or money.

8. Time and expense of an appraisal are eliminated (after original cost has once been established).

9. No contingencies need be added. (These must be approximated in other methods.)

10. Since operating expenses and taxes usually make up 75 per cent of the gross revenue and since fair return on valuation (rate base) is only approximately 7 per cent of valuation, why should there be objection to some slight errors in original cost?

11. Franchise values are usually a matter of *original record*, if worthy of inclusion at all. Present estimates of such early franchise values are usually not accurate.

12. Appreciation of real estate values (unearned increment) represent no service for which consumers should pay.

13. Even though some of the original property may have been built out of surplus earnings, the cost of which should have gone to the stockholders in dividends, this was inaugurated with lower rates at the time and, therefore, such an error may not be corrected now.

14. Early stock was speculative (before regulation was established) and a correspondingly large return was expected. This is not necessary now as there are plenty of speculative stocks for those investors who wish to take a risk. Capitalization should, therefore, represent concrete investment and not watered stock. (This argument should not imply necessarily that other methods of valuation involve watered stock.)

15. Rates, in per cent, applied to the valuation considered as a rate base, may be quickly and readily increased, if necessary, to produce more income without increasing the base itself.

The principal disadvantages of or objections to the "original cost plus improvements" method of evaluation may be considered to be the following:

1. It is not approved, while a substitute method has been approved, by the United States Supreme Court.⁵

In the latest discussion of this subject in the *Indianapolis Water Company Case*, the United States Supreme Court, speaking through Justice Butler, criticizes a valuation of this outstanding private water utility as fixed by the Indiana Commission. The appraisal in this instance was based upon the following interpretation of unit prices by the commission: "Considering all the facts, including all the appraisals and the other evidence concerning the trend of prices, the commission is of the opinion that in this case the average of prices for the ten-year period ending with 1921, the last full ten years available, most nearly represents the fair value of petitioner's physical property." Commenting upon this conclusion Justice Butler says: "But in determining present value, consideration must be given to prices and wages prevailing at the time of the investigation; and, in the light of all the circumstances, there must be an honest and intelligent forecast as to probable price and wage levels during a reasonable period in the immediate future. In every confiscation case, the future as well as the present must be regarded." This language is strongly reminiscent of the majority opinion in the *Southwestern Bell Telephone Company Case*.⁸ Later in the opinion Justice Butler makes his special contribution to interpretations of the "fair value" rule:

It is well established that values of utility properties fluctuate, and that owners must bear the decline and are entitled to the increase. The decision of this court in *Smyth v. Ames*, 169 U. S. 466, 547, declares that to ascertain value "the present as compared with the original cost of construction" are, among other things, matters for consideration. But this does not mean that the original cost or the present cost or some figure arbitrarily chosen between these two is to be taken as the measure. The weight to be given to such cost figures and other items or classes of evidence is to be determined in the light of facts of the case in hand. By far the greater part of the company's land and plant was acquired and constructed long before the war. The present value of the land is much greater than its cost; and the present cost of construction of those parts of the plant is much more than their reasonable

original cost. In fact, prices and values have so changed that the amount paid for land in the early years of the enterprise and the cost of plant elements constructed prior to the great rise of prices due to the war do not constitute any real indication of their value at the present time. Undoubtedly, the reasonable cost of a system of waterworks, well planned and efficient for the public service, is good evidence of its value at the time of construction. And such actual cost will continue fairly well to measure the amount to be attributed to the physical elements of the property so long as there is no change in the level of applicable prices. And, as indicated by the report of the commission, it is true that, if the tendency or trend of prices is not definitely upward or downward and it does not appear probable that there will be a substantial change of prices, then the present value of lands plus the present cost of constructing the plant, less depreciation, if any, is a fair measure of the value of the physical elements of the property. The validity of the rates in question depends on property value Jan. 1, 1924, and for a reasonable time following. While the values of such properties do not vary with frequent minor fluctuations in the prices of material and labor required to produce them, they are affected by and generally follow the relatively permanent levels and trends of such prices. The fact that original cost was probably 12 to 20 per cent less than the estimate of the commission's engineer based on the average of prices for the ten years ending with 1921—two years before the rate order became effective—does not tend to support the commission's adoption of that estimate. The cost of reproduction on price levels prevailing Jan. 2, 1923, was found to be 30 to 35 per cent or from \$4,500,000 to \$5,000,000 more. The average of prices in the ten years ending with 1923—the effective date of the rate order—was shown by the testimony of the commission's chief engineer to produce a result nearly 14 per cent higher than the figure adopted; and, on the basis of prices prevailing on the effective date of the order, cost of reproduction less depreciation would be about 32 per cent higher than that taken by the commission. The high level of prices and wages prevailing in 1922 and 1923 should be taken into account in finding value as of Jan. 1, 1924, and in the years immediately following. Moreover, there is nothing in the record to indicate that the prices prevailing at the effective date of the rate order were likely to decline within a reasonable time—one, two, or three years—to the level of the average in the ten years ending with 1923. And we may take judicial notice of the fact that there has been no substantial general decline in the prices of labor and materials since that time. The trend has been upward rather than downward. The price level adopted by the commission—the average for ten years ending with 1921—was too low. And it is clear that a level of prices higher than the average prevailing in the ten years ending with 1923

should be taken as the measure of value of the structural elements on and following the effective date of the rate order complained of.

Justice Brandeis dissented from the decision. Justice Holmes concurred in the result but presumably did not agree with the theory advanced. In his minority opinion Justice Brandeis significantly remarks:

Nor do I find in the decisions of this court any support for the view that a peculiar sanction attaches to "spot" reproduction cost, as distinguished from the amount that it would actually cost to reproduce the plant if that task were undertaken at the date of the hearing. "Spot" reproduction would be impossible of accomplishment without the aid of Aladdin's lamp. The actual cost of a plant may conceivably indicate its actual value at the time of completion or at some time thereafter. Estimates of cost may conceivably approximate what the cost of reproduction would be at a given time. But where a plant would require years for completion, the estimate would be necessarily delusive if it were based on "spot" prices of labor, materials, and money. The estimate, to be in any way worthy of trust, must be based on a consideration of the varying costs of labor, materials, and money for a period at least as long as would be required to construct the plant and put it into operation. Moreover, the estimate must be made in the light of a longer experience and with due allowances for the hazards which attend all prophecies in respect to prices. The search for value can hardly be aided by a hypothetical estimate of the cost of replacing the plant at a particular moment, when actual reproduction would require a period that must be measured by years.

The Supreme Court has committed itself definitely against the use of any one basis, and in particular against the sole use of original cost. In the *Minnesota Rate Cases* (1913) the Supreme Court said: "The property is held in private ownership and it is that property, and not the original cost of it, of which the owner may not be deprived without due process of law."⁶

2. The original cost is often very difficult to determine. This may result from:

- a. Very early original investment.
- b. Inadequate accounting before regulation.
- c. Accidental or purposeful loss of accounting records.
- d. Faulty accounting for depreciation, replacement, and the possible appreciation of real estate.
- e. Opposition of company to inspection of records.

3. Such a value does not adequately reflect the purchasing power of money or the variation of price levels and monetary standards.

Present Book Value.—Strictly speaking, and assuming accurate accounting methods throughout the years of operation of the corporation, both before and after the period of required commission regulation, the "present book value" should be the equivalent of, if not equal to, the "original cost plus improvements." Or, stated in other words, if the original cost were known, if accurate additions had been made for new equipment purchased, and if proper adjustments had been recognized from time to time for replacement due to both wear and tear and obsolescence, and if, furthermore, there had never been any intermediate appraisals and valuations or any fictitious modifications of assets to provide temporarily expedient valuations for taxation, security issues, rate cases, or sale, then, if all these conditions had obtained throughout the years, the "original cost plus improvements" value would, of course, be identical with the "present book value."

Under such conditions, the same advantages and disadvantages would, of course, apply to both methods, whereas, if such conditions have not existed throughout the years, a new present book value must be determined or the existing value be checked. To do either of these things, an estimate, possibly involving one of the following methods, must be undertaken.

Replacement Value as of Date of Appraisal.—Such a value, which requires an inventory and estimated substitute appraisal, is little used except in a few highly specialized cases in which its necessity is obvious.

As the title implies, the actual property is not evaluated but rather the cost of substitute modern equipment, which will perform the same service, is estimated and used for new valuations, particularly as rate bases.

The engineer and operating executive of a company, intent upon bringing about more economies, may be inclined to favor such a valuation. Its difficulty lies in the impossibility of agreement among engineers as to the proper replacement to be recommended and the revised values to be warranted. It has more justification as a basis for future rates than as a basis for past values and, of course, in no sense represents actual investment.

Reproduction Value as of Date of Appraisal.—“Reproduction value,” as contrasted with “replacement value,” involves the cost of *reproducing as of the date of appraisal the identical equipment* which the inventory shows as existent in the property.

This value, taken in conjunction with adequate depreciation accounting to provide values for the present condition of the property, is in very general use by appraisal engineers and commissions. It has the following prominent advantages and disadvantages:

Advantages.—1. It has the endorsement of the U. S. Supreme Court (see reference 6 previously quoted; also references 7, 8, 9, and 10).

In the *Consolidated Gas Case* the Supreme Court said: “The value of the property is to be determined as of the time when the inquiry is made regarding the rates. If the property, which legally enters into the consideration of the question of rates, has increased in value since it was acquired, the company is entitled to the benefit of such increase. This is, at any rate, the general rule.”⁷

In the noted *Southwestern Bell Telephone Company Case* from which the U. S. Supreme Court is frequently quoted, the following decisions are pertinent:

“It is impossible to ascertain what will amount to a fair return upon properties devoted to public service without giving consideration to the cost of labor, supplies, etc., *at the time the investigation is made.*”⁸

“An honest and intelligent *forecast of probable future values* made upon a view of all the relevant circumstances is essential.”⁹

Most recent and therefore most authoritatively quoted is the case of *McCardle (Indiana Public Service Commission) v. Indianapolis Water Company* (1926):

There must be an honest and intelligent *forecast as to the probable price and wage levels during a reasonable period in the immediate future.* In every confiscation case, the future as well as the present must be regarded. It must be determined whether the rates complained of are yielding and will yield . . . a reasonable rate of return on the value of the property at the time of the investigation and for a reasonable time in the immediate future.¹⁰

2. Valuation should correspond in date to the time the rate thereon is to be earned.

3. Consumers should be charged the rate based upon valuation as of the time and conditions existing during the rate period.

4. Values should vary from time to time with prices and the purchasing power of the dollar.

5. Losses during previous years (during which a fair return might not have been earned) may be more readily provided.

Disadvantages.—1. The *Knoxville Case* (upon which much of the unfavorable argument has been based) involves inadequate adjustment for depreciation, and is, therefore, a basis for present value rather than reproduction value.

2. The proper unit prices to apply to provide adequate reproduction values are difficult to determine equitably:

- a. If prices have been varying widely in the past, future forecasts and extrapolations of trend prices are necessary.
- b. Fluctuating prices cannot be followed by frequent appraisals.
- c. Protected from competition, public utilities should forego the implied appreciation of real estate values.

3. Present construction conditions (necessarily assumed for reproduction) are different from those which existed in the actual installation.

- a. Early construction conditions are not always known at time of appraisal.
- b. Pavements to be replaced and construction railroads to be used for reproduction probably are not those originally encountered. Such may prove ultimately a double burden on the consumers because of higher valuations involved in this method.

In the building of a street railway line it may have been necessary to grade the streets. In determining, years later, the cost of reproducing the property, must we assume that the streets will again have to be graded, even though today they are as level as a floor? In the construction of the Los Angeles aqueduct through the Mojave Desert, caterpillar tractors were used because there was no railroad. Subsequently a railroad was built near the aqueduct. In determining the cost of reproducing the aqueduct at the present time, are we obliged to assume that the railroad is nonexistent? Most public utilities' properties are constructed piecemeal; they do not come into being at one fell swoop. . . . To construct the plant piecemeal is usually more expensive than to construct it all at one time.¹¹

- c. A hypothetical case must be assumed rather than a real property.
 - 4. There is usually a lag in time adjustment, particularly during periods of decreasing prices.
 - 5. Real estate should not be valued as of the present time, regardless of what it actually involved in original investment. It might have been donated to induce the company to locate at a definite place.
 - 6. Frequent valuations, usually necessary if based upon reproduction costs, are expensive and tend to undermine credit and public opinion.
 - 7. Stockholders are entitled to a return only on their investment actually risked.
 - 8. An opportunity is provided for the introduction of items of value in the inventory and appraisal which are extraneous and not pertinent to the true values.
 - 9. "The reproduction theory contemplates an imaginary community in which an imaginary corporation makes imaginary estimates of the cost of an imaginary railroad."¹²
- Of course, it will be immediately noted that the "reproduction new" method provides a generous opportunity to capitalize high prices and take advantage of appreciation of property. In the case of railroad roadbeds, which are much more valuable when a few years old than when new, and with real estate in a prosperous and rapidly growing environment, there is often a rather formidable "unearned increment" which enters into the reproduction new valuation and which was not present in the original investment or in earlier appraisals. The basic question upon which there has been so much difference of opinion, even in the highest courts of the land is: should the corporation, i.e., its stockholders and officials, profit more by such appreciation or should the consumers have lower rates as a result thereof? In the famous *Minnesota Rate Cases* as well as in several subsequent confirmatory decisions, the U. S. Supreme Court has recognized the necessity of taking such appreciated values into consideration in utility valuations.
- Although it may be surprising to learn that, in spite of the rather formidable disadvantages listed against the "reproduction method," the U. S. Supreme Court has recorded more favor upon it than upon any other procedure and it has been used most extensively by commissions and consulting engineers.

Referring again to the previous quotation from the now classic *Indianapolis Water Company Case*, it should be noted that the pure "reproduction method" is modified by the statement: "the present as compared with the *original cost of construction* are, among other things, matters for consideration. But this does not mean that the original cost or the present cost or some figure arbitrarily chosen between these two is to be taken as the measure. The weight to be given to such cost figures and other items or classes of evidence is to be determined *in the light of the facts of the case in hand.*"⁶

This recognition of the necessity of taking several possible methods of evaluation into consideration in order to arrive at the most equitable *fair value* for all concerned in each specific case is emphasized by the following example of the variation in values resulting from the various methods when determined as nearly justifiably as possible by experts in valuation.

This appraisal is from the Report of the Engineers' Valuation Board *in re Pittsburgh Railways Company*, dated Aug. 6, 1919, and submitted to the Public Service Commission of Pennsylvania. The board was composed of five members, two representing the city of Pittsburgh, and the chairman representing the commission, who was its chief engineer. The result of this investigation is set forth on pages 5 and 6 of the report:

"With the purpose of providing these measures of value specified in the Public Service Company Law,* the board has had prepared a statement of the historical cost as determined from the records, and estimates of the reproduction costs of the physical property based upon several interpretations of the fair average price of materials, property, and labor.

"We find the cost of the physical property, as determined from the records and if reproduced upon the various bases of pricing, to be as follows:

"Basis No. 1—Historical cost as determined from the records, with scrutiny of engineers and accountants, representing the <i>actual investment</i> in physical property placed in the service of the public.....	\$ 59,069,382
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"Basis No. 2—Estimated cost of reproduction new at prices ruling when each part of the existing property was constructed and under original conditions of construction	49,324,791
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* The Public Service Commission Law copies practically verbatim the rate-making rule of *Smyth v. Ames*.

"Basis No. 3A—Estimated cost of reproduction new at average prices of the period 1906 to 1915, inclusive, and under original conditions of construction.....	56,148,398
"Basis No. 3B—Estimated cost of reproduction new at prices indicated for 1913 by the trend of prices for twenty years previous to 1916, and under original conditions of construction.....	60,832,200
"Basis No. 3C—Estimated cost of reproduction new at average prices of the period 1914 to 1918, inclusive, and under original conditions of construction.....	73,560,300
"Basis No. 3D—Estimated cost of reproduction new at the estimated average prices of the period from 1918 to 1922, inclusive, and under original conditions of construction.....	84,191,300
"Basis No. 4—Estimated cost of reproduction new at prices and under the conditions ruling at the date of valuation, viz., Apr. 1, 1918.....	102,842,274

"These figures include real estate and right of ways; organization and development cost prior to construction; engineering, legal, and administrative expenses; interest and taxes during construction; cost of financing; materials and supplies and working capital necessary for operation. . . .

"The historical cost as found includes superseded property in the following amounts:

Horse-car system.....	\$1,542,178
Cable system.....	3,778,639
Early electric equipment and construction.....	5,950,641

"A large portion of this property was superseded when in good operating condition and in particular the cable systems were in operation for only seven years.

"We find the accrued depreciation of parts of the physical property as of Apr. 1, 1918, to have been as follows:

Prices Used in:

Basis No. 2.....	\$12,039,600
Basis No. 3A.....	12,733,100
Basis No. 3B.....	12,869,700
Basis No. 3C.....	16,845,200
Basis No. 3D.....	19,364,000
Basis No. 4.....	23,775,500

"These estimates are based upon detailed inspection of condition with consideration of elapsed and of estimated remaining life. They include such overhead charges as enter into the cost of replacements."¹⁸

Another example of the wide divergence between original cost and reproduction value and the tendency of the U. S. Supreme Court to devote greater weight to the latter is concisely set forth in the following Table XVI, referring to the case of the Indianapolis Water Company.

TABLE XVI.—VALUATION OF THE INDIANAPOLIS WATER COMPANY*

Actual cost of property.....	\$10,434,254
Actual cost plus increase of land value.....	12,750,000
Valuation by Public Service Commission.....	15,260,000
Valuation sustained by Supreme Court.....	19,000,000
Present cost of reproduction, not more than....	21,750,000
Valuation, if original cost and reproduction cost had been given equal weight.....	16,092,124
* Money invested to Jan. 1, 1917.....	\$ 8,000,000
Capital additions, Jan. 1, 1917, to Oct. 31, 1922.....	1,639,146
Capital additions, Oct. 31, 1922, to Dec. 31, 1923.....	795,105
 Total.....	 \$10,434,251

The salient facts shown by this table are that the court was not satisfied with the commission's allowance of 46 per cent above original cost, nor with 50 per cent of the difference between original and reproduction cost, but sustained a valuation which is 82 per cent above original cost and which includes 75 per cent of the difference between original and reproduction cost. Previous to this decision the Supreme Court had never allowed as much as half of this difference. There is no doubt that it gave "dominant consideration" to reproduction cost!¹⁴

For the effect of such large valuations upon the owners of the company and the rates that consumers have to pay for service, further reference should be made to Chaps. XX, XXI, and XXVIII.

Present Value as of Date of Appraisal (Considered as Reproduction Value Less Depreciation).—The careful and comprehensive consideration by the commissions, and usually later by the courts on appeal, of all the pertinent methods of evaluation usually results in a compromise value for rate-base purposes which may be called present fair value. This usually takes into consideration the depreciation that has taken place from the time of installation (particularly for the larger items of equipment) and the extent to which such depreciation has been neutralized in balance-sheet values by adequate depreciation reserves in the accounting system.*

* See Chaps. XVI and XXVII on accounting, and Chap. X on depreciation.

Either the physical values of the property, by whatever method evaluated, must be reduced by the depreciation that has taken place since its installation, determined by either an age calculation or an engineering inspection or both, or else the depreciation reserve, if found adequate to neutralize all depreciation and obsolescence, must be included as an asset value upon which a certain specified percentage return may be earned by the corporation. Careful analysis of the present status of the property and of the adequacy of the accounting system is necessary in order to determine this true present value for a rate base and it is usually established after long and tedious commission and court hearings.

Since the consumer usually pays, in the form of higher rates, either directly or indirectly as the result of the added expense of such delayed hearings, they should not be undertaken too frequently.

Organization Expense and Construction Allowances.—Closely affiliated with tangible property, and often considered as a part of the value thereof, must be considered the following expenses *during the organization period* of the corporation and the *construction of the plant* before any revenue is forthcoming:

1. Promotion expense.
2. Securing of licenses and permits.
3. Legal fees.
4. Engineering expense.
5. Superintendence.
6. Interest and taxes.
7. Contingencies.

Most of these values are self-explanatory and readily evaluated. If the plant is not too old and the accounting system is adequate, definite figures can be obtained from the books or contractual records for the first five of these. Frequently "Engineering expense" and "Superintendence" are justifiably evaluated as a predetermined percentage of the physical property upon which such services are rendered. A charge of from 5 to 7 per cent for each service is usually considered appropriate.

Interest during construction is usually added for one-half the period previous to operating return, on the assumption that money is borrowed as the construction progresses and at least 50 per cent of the total value bears interest before any return is enjoyed. If a definite record of all bond issues and notes is

available, an actual charge rather than an estimated percentage may be introduced.

A definite analysis of the interest factor in one valuation of a large electric railway and power system is outlined in the following table.

TABLE XVII.—CARRYING CHARGES OR INTEREST DURING CONSTRUCTION
(Based on a Three-year Period with Interest at 6 Per Cent Per Annum)

	Total investment	Interest, per cent	Total interest
Overhead distribution system (except services).....	\$ 923,213.47	9.0	\$ 83,089.21
Underground distribution system.....	793,309.60	9.0	71,397.86
Steam-heat distribution system.....	330,962.79	9.0	29,786.65
Real estate	215,481.00	6.75	14,544.97
Buildings.....	409,837.61	6.0	24,590.26
Power plant.....			
Equipment.....	1,724,341.54	4.5	77,595.37
Transformers.....	276,642.25	4.5	12,448.90
Lighting fixtures.....	109,004.93	4.5	4,905.22
Services.....	260,614.15	4.5	11,727.64
Meters.....	436,480.31	3.0	13,094.41
Total.....	\$5,479,887.65	....	\$343,180.49
Average interest.....		6.24	

Contingencies also, usually expressed as a percentage of the entire valuation previously summarized, vary with the degree of accuracy and detail with which the appraisal has been undertaken. Some of the largest contractors have reported that estimates of reproduction values upon physical plants would not average nearer than 15 per cent owing principally to (1) errors of judgment, (2) fluctuation in prices of material, (3) difference in personnel of organizations estimating, and (4) variation in weather and labor conditions.

Conclusions.—The percentages in Table XVIII have at different times been used by engineers in valuation work and, subject to revision for local conditions, will adequately provide for "overhead allowances during construction."

These expenses cannot be added to obtain a total overhead charge since the first six items will apply only to certain classes of physical property while the remaining ones apply to the enterprise as a whole. Again many of the charges discussed apply only to labor costs, while

some, in turn, apply to both labor and material expense. Also some of the above charges will not apply if others are used, i.e., architects' fees replace engineering expense. It might be well to reiterate at this point that the first six items above given should be, so far as may be

TABLE XVIII

	Per Cent
1. Engineering and superintendence.....	5 to 15
2. Incidentals or contingencies.....	5 to 20
3. Organization expense.....	3 to 5
4. Architects' fees.....	5 to 10
5. Real estate expenses.....	5 to 7
6. Purchasing and handling.....	2
7. General legal and corporate expense.....	5
8. Contractors profit (labor and material).....	10
9. Taxes during construction.....	$1\frac{1}{2}$
10. Insurance during construction.....	$1\frac{1}{2}$
11. Interest during construction (per annum).....	Legal rate
12. Promotion expense.....	8
13. Cost of financing.....	5 to 15

possible, worked into the individual unit costs (see Chap. IX). Properly they should not be referred to as "overhead charges."

While these percentages will vary somewhat, according to the size of the property involved and the location in which the same is situated, still, as a general average, they represent charges which should be added to the cost of material and labor in place, in order to obtain the total cost of the physical property.¹⁵

Intangible Values.—In addition to the actual physical values, which, it has been shown, cannot be estimated very accurately, there are certain intangible values that should be given some consideration, and in some instances they may be recognized as legitimate accretions to the rate base. Such possible items are:

1. Franchise value.
2. Good will.
3. Going value.
4. Patents.
5. Fixed charges (particularly during construction).

Of these intangibles, only going value (in a few instances) and fixed charges during construction have been given very much consideration by courts and commissions during recent years as a possible increase in the valuation or the rate base. Their relative

merits and the basis for their adoption or elimination in all but very special cases are outlined as follows:

Franchise Value.—Some experts, and even commissions and courts, have considered that, since a franchise which had been granted to a public utility in the past provided a means of obtaining increased earning capacity and income, some value should be given to the franchise in determining the assets of the corporation. This corresponds, in part, to the well-known "good will" of the private business. However, many commissions have refused to recognize such a value and in some states a definite provision has been made by law prohibiting such a valuation. These acts are based upon the belief that a privilege granted to a monopoly by the people should not be used as a further tax or burden upon those people, i.e., the consumers of the service of such a monopoly.

Even in cases where franchise value has been allowed, a great difference of opinion has existed as to the proper method for its determination. Since most franchises have been surrendered by public utilities for "indeterminate permits,"* no values need be considered for the former unless they are still active and it can be shown that a definite payment had been made by the corporation for securing such a right which is still of value in rendering service to the community. In many states, therefore, the actual cost of obtaining the franchise determines its maximum possible value.

Good Will.—Whereas a private manufacturing or merchandising corporation may have established, as the result of the development of a particularly attractive product, especially effective advertising, or a most important location, some values that tend to make its particular business one toward which customers naturally concentrate their attention and purchasing power in the face of competition, this is not possible for the public utility, which is a regulated monopoly. "Good will," therefore, which has been well defined as "the probability that the old customers will resort to the old place,"¹⁶ may be a valuable asset for a private concern, but is never recognized (as defined above) for public utility corporations.

Going Value.—The nearest approach to the good will of a merchandising establishment which exists in a public utility

* See Chap. XXVI.

corporation is designated as "going value." How much more is a successful concern worth which renders extra good service and which has been built up as the result of years of economic expenditure and efficient administration than one which just exists within the law and renders unattractive, although passable, regulated service? Shall the company that did not earn a fair return during its early years of existence, when it was building up its service and credit, be permitted to earn now a larger percentage net income as the result of a higher intangible valuation—that increment being known as going value?

Commissions and courts usually recognize some value for such an intangible item, over and above the physical value, but its method of calculation is, as yet, far from standardized. The most plausible methods that have been proposed from time to time, as well as a composite of some of those usually recognized in most rate cases, are included in this list:

1. *Capitalizing Net Earnings.*—Although this method was illustrated by a concrete calculation in Chap. XII, the impracticability of its use in noncompetitive regulated business such as public utilities was also demonstrated.

2. *Cost of Reproducing Net Earnings.*—This method, which has been used in many cases and endorsed by several commissions, was explained in considerable detail in a paper by Mr. John W. Alvord on "Notes on Going Value and Methods for its Computation" in 1909.¹⁷ If detailed information is at hand regarding the costs of the early establishment of the business, it may be used as a guide toward the determination of an equitable going value. It is assumed that upon the date of the appraisal the existing plant and all its business will be wiped out and that under the reproduction theory an identical plant will be reconstructed and business reestablished as quickly as practicable. The community will remain normal and will follow its natural growth while the system is being rehabilitated. Some estimated lapse of time will result before the revenues of the new fictitious plant will reach those of the present plant, thus involving some loss during the constructive years. Such a loss, determined usually by graphical methods, is discounted back to its present value (see Chaps. XIII and XIV) and is considered to be the present worth of the going value. Total revenue, commercial revenue, and operating expenses are plotted for past years in

order to determine the trend of the curves as indicated in Fig. 24. These trends are extrapolated into the future, thus determining a date upon which the revenues of the two plants will coincide. In this figure it required seven years for the new plant to acquire

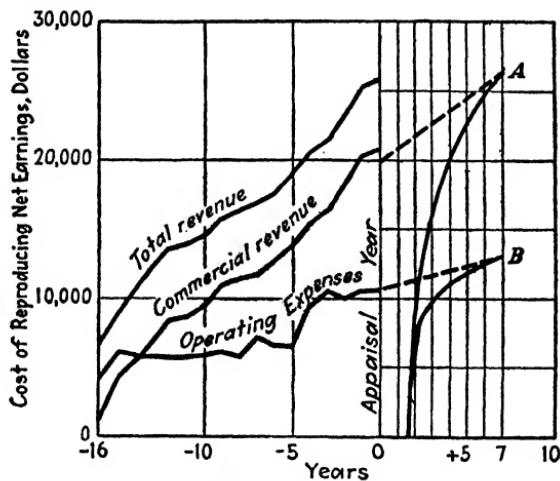


FIG. 24.—Cost of reproducing net earnings.

the commercial revenue and operating expenses of the actual utility corporation, of which one and one-half years was con-

TABLE XIX.—PRESENT WORTH OF GOING VALUE

Present plant		New plant					
Years elapsed before appraisal	Commerical revenue	Commerical revenue	Difference in operating expenses	Total credits	Annual going value	Present worth factor	Present worth of going value
2	\$21,800	\$ 8,500	\$3,500	\$12,000	\$9,800	0.952	\$9,330
3	22,720	16,000	1,500	17,500	5,220	0.907	4,735
4	23,640	19,500	800	20,300	3,340	0.864	2,886
5	24,560	22,500	400	22,900	1,660	0.823	1,367
6	25,480	24,800	.....	24,800	680	0.784	533
7	26,400	26,400	.....	26,400	0	.....	0
							\$18,851

sidered to be the construction period during which there was no revenue.

These curves do not provide the going value directly, but rather a means of calculating such a value. It must be determined each year until the revenue curves meet. Then all annual values are reduced to a present worth. Such calculations, corresponding to the curves of Fig. 24, are given in Table XIX. The estimated present worth of the going value is therefore \$18,851.

In summarizing twenty cases, thus calculated in Mr. Alvord's paper, the ratios of going value to physical value vary from 9.6 to 47.0 per cent, indicating that no fixed ratio can be applied, as is sometimes assumed in other rate hearings. Neither is there any correlation with growth of population, with the number of service connections established during the period, or with gross revenue. The period of recovery in these twenty cases varied from $5\frac{1}{2}$ to 11 years, although in some other calculations a period as long as 20 years has been found necessary.

A brief justification of this system is quoted from a report of Mr. Benezette Williams before the Wisconsin Railroad Commission in the *Beloit Case*:¹⁸

All utilities that are distinctly public ones have a continuing existence. The acquired revenue of such utilities is also continuing and is a basis of an element of value which augments the physical value. This element is the "going value," or the potential business value, the amount of which must be determined by the net income which a plant in operation will have in excess of what a substitute plant of like character, the construction of which is begun at the time of valuation, can produce, the annual excess earnings being reduced to present worth.

One criticism of this method, proposed in a New Hampshire case, is presented as follows:

The conditions which would exist if the prosperous communities of _____ were suddenly deprived of electricity—are unthinkable. No such thing has ever happened. And yet engineers do not hesitate to testify as to just how long it would take these same people, if it did happen, and the plant were reconstructed, to make up their minds that electricity would be a good thing for them, and by intricate calculations to show the exact amount which the company would lose during the time required to "educate" the intelligent citizens of these towns up to that point of the value of electricity to which they have already attained. And this it is claimed must be allowed as going value. . . .

There is another absurdity in the reproduction theory which is suggested by the consideration of the developmental period. It is assumed that the plant is to be reconstructed complete as at the present day, with every extension, not merely to the premises, but into the very houses, including the actual installation of meters, for people who are not going to use the electricity for a period of three or four years after the construction is completed. Such a thing has never been done, and never would be done by sane men.¹⁹

3. *The Capitalized-losses Method.*—Although this method (see Chap. XIII), which capitalizes the deficit of net earnings which may have existed below those subsequently allowed under commission regulation, has been presented before commissions and courts in many hearings, it has been rather generally discarded because of its tendency to favor past inadequacy of administration or actual mismanagement of the property or because it is usually recognized that those who are likely to gain by such an increased valuation in the future are not those who have suffered from inadequate returns during past years. Furthermore, early losses have frequently been more than neutralized by the subsequently increased profits and "it is a poor rule which will not work both ways." However it is probable that any attempt to reduce valuation, because of past excessive profits, would be immediately hailed as confiscation of property and therefore considered as unconstitutional.

If such a calculation of possible going value is given any consideration at all, it should be done only in such cases as are evidenced by an efficient management, in connection with which moneys that might otherwise have gone to stockholders in the form of dividends or to operating expenses have been definitely expended to build up a larger "going concern."

4. *The Cost-of-development Method.*—This method, which frequently receives recognition in cases where actual expenditures for development can be shown which are distinctly capitalistic and not operating expense, may be best described by quotation from a very comprehensive paper upon the subject by Frank F. Fowle:²⁰

The development and up-building of any business commonly calls for expenditures beyond those which represent tangible property. Thus there is the matter of advertising and display, to educate the public. Special inducements to try the service are quite common, such as free

house piping, or the installation of piping or wiring at the cost of labor and materials, or less than cost, with a long period in which to pay on the installment plan; also the sale at less than cost of various household utilities which consume water, gas, or electric energy; and sometimes the use of free water, gas, or electricity is offered for a limited period. There is also the matter of canvassing to obtain business, and to show consumers how to utilize the service economically and at the same time effectively.

Such costs are almost always present, and are ordinarily most burdensome during the early years or development period of the business. They may have been charged to capital or to operating expense, but in either case it seems necessary to consider them as one of the legitimate elements of cost, under the cost-of-service theory. The Wisconsin commission has expressed substantially this view of the matter, in connection with discussions of going value.

Probably it was common practice in nearly all cases to treat such costs as part of the operating expense. Thus the burden of business development fell heavily on the earnings of the early years and possibly diminished or wiped out the profits for a time. Accepting this as a fact, it is obvious that the capitalization of deferred profits is a method of computing the so-called going value which fully covers the cost of developing the business up to the point of being a profitable going concern.

As regards latter day practices, it may be observed that the cost of getting business is divisible, at least for discussion, into two parts; one covers the expense for holding the present volume of business and the other covers the expense of securing an added volume of business. It has been proposed that the first part should be charged to operating expense and the second part to construction or capital account. Such a division seems to be equitable enough, but there is some doubt as to whether it is altogether conservative. The creation of intangible values, or the addition to physical values of expenditures which do not represent physical property, ought to be restrained rather than encouraged. In other words, it cannot be regarded as conservative to attempt to build up values which do not represent tangible property. Therefore there is good reason for charging the cost of securing business to operating expense.

Selling cost, in a private business, is as much an element of the expense of doing business as the outlay for raw materials, or manufacturing cost, or overhead expense, and there is a continuing outgo of this character. If it is proper in a private business to treat selling cost as a part of the operating expense, is it not equally proper in a public utility? If the outlay in the latter case is made unusually large in order to attract, say, a new class of business, the expectation is that the

later profits will more than cover the cost. It is also true that, if the selling cost is charged to expense, there will be more effort to supervise it and hold it to a reasonable amount than would be the case if it were charged to capital account.

Whichever way we conclude in the matter, selling cost, or the cost of building up and holding a going concern, is a legitimate outlay which we must recognize under the cost of service theory. In the case of an adjustment of rates at this time, the form or manner in which we recognize it is not so essential as the fact. Again we may observe that this is not going value in the broad sense, but simply an element of cost which demands recognition.

5. *The Merged-securities Method.*—Mr. Fowle, in the above reference, also describes a method under the title of "merged securities," which may justify a valuation in excess of the summation of the physical net worths of two consolidated utility corporations which may have been in partial or complete competition with one another.

Such valuations, during the past two decades of marked consolidation, may be more satisfactory than further duplication of competing corporations but it is believed that they should be considered as merger capitalization (see Chap. VII) under regulation of most state commissions rather than as a special case of going value.

General Conclusions on Going Value.—Thus it will be seen that the term "intangible value" is correctly applied to the so-called going value or going concern value. It is a value which must be dealt with in most valuation problems and yet one which has received volumes of discussion from so many schools of thought, each with its supporting evidence and its forceful advocates, that careful detailed analysis is necessary to determine whether and to what extent such a value attaches to each property.

Mr. Fowle summarizes his comprehensive treatise upon the subject as follows:

1. Under the cost of service theory we seem bound to recognize every element of actual cost, for both tangible and intangible property, which is legitimate, reasonable, and necessary.

2. Going value, under the cost of service theory, cannot be supported by capitalized net earnings in excess of a fair return on the cost value of the property.

3. Rigid rules for measuring the legitimate going value, if any, under the cost of service theory, cannot safely be laid down because the local circumstances in each case are different and each issue should be treated on its merits.

4. The general test for value of any kind, under the cost-of-service theory, is always the cost, but this may be tempered by the great desirability of distributing justice and equity to both the public and the utility companies in equal measure.²⁰

The Indiana Public Service Commission frankly states its reason, which is no doubt that of many commissions, for allowing going value as "the courts seem to require it."

The commission has held that the major purpose of an allowance of going value is to cover out-of-pocket money expended by the utility during the period of construction and development for invisible capital assets which are not susceptible of physical appraisal, as, for example, the cost of establishing the business.

The courts, however, have held that regardless of historical considerations a utility property has a going value in excess of the value of its physical property for the reason that the business is established and the property is a going concern.²¹

Patents.—The subject of patents, particularly for public utility corporations, is quickly disposed of. Patents owned and various patent rights, licenses, and royalties may be considered by the manufacturing and merchandising corporations as valuable assets, often tangible as well as intangible. Their padded values are, however, sometimes unfortunately introduced into the balance sheet to the disadvantage of stockholders. A patent which has passed through the inevitable modern barrage of court litigation and which has yet several years of life is, of course, a valuable asset if it is basic for the manufacturing processes of the corporation and if it cannot be readily "designed around" with equally satisfactory unpatented or otherwise legitimate competition. The public utility has no such equivalent asset and the private corporation too often relies upon patent rights for too high speculative values.

Fixed Charges.—Since the only fixed charges that might enter into the valuation are those incurred during the period of organization and construction of the plant, these have been adequately explained under the foregoing subtitle, Organization Expense and Construction Allowances.

Summary.—Several methods of determining the valuation of a public utility property have thus been outlined. Each has its merits and its occasional and timely local application. The resulting value, after a commission hearing and possible court appeal have been concluded, is usually a composite of two or more proposals, the final amount being of particular interest, not only to officials and stockholders of the company, but to consumers, constituents, and municipal officers as well. Both public utility rates and taxes are often involved, as indicated in Chap. XXVIII, and, because of the monopolistic character of the business and the resultant necessity of state and possibly federal regulation, more publicity and study have been associated with such valuations than with those of private enterprise.

However, the principles of inventory, appraisal, and balance-sheet testing of assets of such a business should be carefully studied by the officials and the stockholders of private manufacturing and merchandising companies, as indicated in Chaps. XVI, XVII, and XIX, for the published balance sheet frequently either sets forth assets such as "patent rights" and "good will" which may prove of questionable or inestimable value or else may fail to disclose in sufficient detail the true values of the corporation for the effective use of stockholders.

Specific References

1. *Minnesota Rate Case*, 230 N.S. 434.
2. Justice Brandeis, 262 N.S. 276, 290 (1923).
3. Justice Brandeis, 181 Wis. Rep. 281, 301 (1923).
4. JONES, ELIOT, and TRUMAN C. BIGHAM: "Principles of Public Utilities," p. 240, The Macmillan Company, New York.
5. *Indianapolis Water Company Case*, P.U.R. 1923-D, p. 514. Also MARTIN G. GLAESER, "Public Utility Economics," pp. 476, 477, The Macmillan Company, New York.
6. GLAESER, *loc. cit.* Also 169 U.S. 466, 547.
7. JONES, ELIOT, and TRUMAN C. BIGHAM: "Principles of Public Utilities," p. 220, The Macmillan Company, New York. Also 212 N.S. 19, 52 (1909).
8. JONES and BIGHAM, *op. cit.*, p. 217. Also *Southwestern Bell Telephone Company Case*, 262 U.S. 276, 287-288 (1923). See also *Indianapolis Water Company Case*, 272 U.S. 400, 408 (1926). Italics by Jones and Bigham.
9. JONES and BIGHAM, *op. cit.*, p. 218. Also 262 U.S. 276, 287 (1923). Italics by Jones and Bigham.
10. JONES and BIGHAM, *loc. cit.* Also 272 U.S. 400, 408-409 (1926). Italics by Jones and Bigham.

11. JONES and BIGHAM, *op. cit.*, p. 212.
12. JONES and BIGHAM, *op. cit.*, p. 238.
13. GLAESER, *op. cit.*, pp. 462, 463.
14. RYAN, JOHN A.: "The Ethics of Public Utility Valuation," The National Popular Government League, Washington, 1928.
15. KEALY, P. J.: "Overhead Charges in Valuation." Also a part of Valuation Committee Report A.E.R.A., *A.E.R.A.*, vol. 5, no. 3, American Transit Association, New York.
16. *Cantwell v. Lee*, 17 Ves., p. 335.
17. American Water Works Association, Milwaukee, 1909. Also *Proc. Am. Soc. Civil Eng.*, vol. 73, p. 326.
18. W.R.C.R. 276, Wisconsin Railroad Commission Reports.
19. Re: *Grafton County Electric Light and Power Company*, P.U.R. 1916-E, pp. 879, 887.
20. FOWLE, FRANK F.: "Going Value," *Trans. Western Soc. Eng.*, vol. 17, February, 1912.
21. Re: *Laporte Gas and Electric Company*, P.U.R. 1921-A, 824, p. 865.

General References

- BAILEY, WARREN G., and D. E. KNOWLES: "Accounting Procedures for Public Utilities," McGraw-Hill Book Company, Inc., New York.
- BARNES, IRSTON R.: "Cases on Public Utility Regulation," Yale University, Edwards Brothers, Inc., Ann Arbor, Mich.
- BOWERS, EDISON L., and R. HENRY REWNTREE: "Economics for Engineers," McGraw-Hill Book Company, Inc., New York.
- CABOTT, PHILIP, and DEANE W. MALOTT: "Problems in Public Utility Management," McGraw-Hill Book Company, Inc., New York.
- DORAU, HERBERT B.: "Materials for the Study of Public Utility Economics," The Macmillan Company, New York.
- FISH, J. C. L.: "Engineering Economics," McGraw-Hill Book Company, Inc., New York.
- GLAESER, MARTIN G.: "Outlines of Public Utility Economics," The Macmillan Company, New York.
- GRANT, EUGENE L.: "Principles of Engineering Economy," Ronald Press Company, New York.
- IGNATIUS, MILTON B.: "The Financing of Public Service Corporations," Ronald Press Company, New York.
- LAGERQUIST, WALTER EDWARD, "Investment Analysis," The Macmillan Company, New York.
- MARSTON, ANSON, and THOMAS R. AGG: "Engineering Valuation," McGraw-Hill Book Company, Inc., New York.
- MONTGOMERY, R. H.: "Financial Handbook," Ronald Press Company, New York.
- NASH, L. R.: "The Economics of Public Utilities," McGraw-Hill Book Company, Inc., New York.
- RUBET, HARRY: "Industrial Organization," Ginn and Company, New York.
- SALIERS, EARL A.: "Accountant's Handbook," Ronald Press Company, New York.

Review Questions

1. List the purposes for which a valuation might be made.
2. Distinguish between an inventory, an appraisal, and a valuation.
3. What is meant by "going concern" value?
4. Explain why the capitalization of a corporation may be less than, equal to, or in excess of its true valuation.
5. Explain why the valuations set by a company's own engineers, a valuation and appraisal company, and a public service commission might equitably vary widely.
6. In the valuation of a certain hydroelectric property there appeared an item of \$1,000,000 entitled "Engineering supervision." Upon investigation the court ruled that the item was excessive as it contained an exorbitant amount of interest paid during construction. Name the ways in which the engineers in charge of the project during construction might have reduced this item.
7. Which of the five valuations—original cost plus improvements, present book value, etc.—is most commonly used and why?
8. What are the advantages and disadvantages of each of the above five valuations.
9. Explain why "good will" might have a value which legitimately might be included in a valuation.
10. A certain utility owns an office building, only two floors of which are directly used by the utility; the remaining three floors are rented out as offices. How should this building be handled on an appraisal made to establish a rate base?
11. A certain street railway company has a number of large interurban-type cars which were left over after the system was equipped with "one-man" cars. The company uses them occasionally when large gatherings occur. Should they be included in a valuation? Why?
12. A certain transportation utility owns and operates a large amusement park which it claims brings in a large revenue from transportation to and from this park. Should they be allowed to include this park in the valuation of their transportation system for (a) rate base; (b) taxation? Why?

CHAPTER XII

CAPITAL AND CAPITALIZATION

Even before the articles of incorporation have been prepared or a charter granted to the prospective corporation by the Secretary of State, four pertinent questions are usually asked and more or less satisfactorily answered:

1. What shall be the relation between "capital" and "capitalization"?
2. How much capital is necessary?
3. Where is it coming from?
4. How much should be furnished by stockholders and how much should be borrowed?

1. **"Capital" and "Capitalization."**—The terms "capital" and "capitalization" are often used interchangeably as synonymous terms. This usage is not strictly correct and often leads to misunderstanding. "Capital," strictly speaking, properly describes the wealth of the corporation or its actual value expressed in terms of real estate, machinery, finished stock, raw materials, franchises, patent rights, etc. It is rather closely related to the tangible assets of the business.* "Capitalization" refers to the summation of the par values of bonds and stocks authorized and issued in the name of the corporation, including all forms and dates of issue.

Since the capitalization, thus defined, represents a definite tangible amount authorized by the charter, while the value of the capital or property of the company varies from time to time with the market, its physical condition, etc., *there can be no fixed ratio between capital and capitalization.* It is to be supposed, of course, that at the time the funds represented by the capitalization were expended, if the corporation received full value for its investment, the capital and the capitalization of the corporation were, for a brief period, equal. The readiness with which a corporation becomes overcapitalized or undercapitalized, therefore, becomes at once apparent. Although one usually hears more criticism

* See Chap. XI on The Process of Valuation.

of overcapitalization and its near relative, stockwatering, yet undercapitalization or the underestimating of the capitalization necessary, particularly for a new corporation, may prove more disastrous than the former difficulty. The problem of proper adjustment of capitalization to capital and the real needs of the corporation is one that lies at the very foundation of business. Wherever this ratio is controlled by the state, particularly in the case of public service corporations, the frequent valuations of the property of the corporation and the limitation or approval of requests for increased capitalization make up a large portion of the tasks of the commission or board having jurisdiction over such a matter.

One fairly satisfactory adjustment of capitalization to true capital which is being more generally adopted each year is the elimination of the so-called par value of stock.* "Par value" is at best a more or less fictitious amount which, unfortunately, has some significance in law, but which often misleads the amateur and uninformed public into the belief that it measures, in some vague manner, the true value of the shares of stock. With a capitalization of \$100,000, for example, a corporation having 1,000 shares of stock outstanding simply divides its capitalization into 1,000 equal parts. The holder of each share has a one-thousandth part of the total votes and the dividends declared. If the *capital* of the company, however, is valued at \$50,000, the true worth of one share of stock is, of course, only $\$50,000/1,000$ or \$50. Similarly, if the capital increases in value to \$150,000, one share is worth \$150, etc., regardless of the fact that the certificate of stock may bear the words "Par value \$100." Without a par value for the stock, overcapitalization and stock water-
ing are practically impossible since the reference base, with which the new value is to be compared, has been removed. This does not mean that worthless securities would not continue to exist, but rather that a more accurate measure of their worth might be forcefully brought to the attention of the prospective pur-
chaser. In some states the statutes now permit the issue of stock with no-par value attached, and these will frequently be found advertised for sale. An increasing tendency for states to *permit* stock to bear no-par value seems to be evident, if, indeed, this is not required.

* See also Chap. III on Stocks, Notes, and Bonds.

If the property, labor, etc., secured by the corporation are at the time of purchase overvalued, or if these have depreciated in value since their acquisition by the corporation, or if they have been reevaluated by some commission, the capital will have less tangible value than the stocks at par issued to represent such capital and the organization is said to be overcapitalized. If, on the contrary, the real estate and other property of the corporation have, for any reason, appreciated in value since incorporation, undercapitalization results.

However, the problems of undercapitalization and overcapitalization are much more complex than indicated by the above variations in the appraised value of property. The market values of stocks and bonds are determined principally by the earning power of the investments they represent and by the law of supply and demand of the stock and bond markets. If stock, the par value of which is \$100, is selling at \$300 and paying, over a considerable period of time, a dividend of 15 per cent, it may be reasonably assumed that the corporation is undercapitalized. With the capitalization trebled, the stock would sell approximately at par with a 5 per cent dividend provided the same conditions of earning capacity continued. Similarly, where stocks are marketing continuously under par, with no other abnormal conditions existing, it may be assumed that the enterprise is overcapitalized.

It must not be assumed from the above example of the adjustment of undercapitalization, involving the trebling of the capitalization in order to reduce the dividend from 15 to 5 per cent, that such a practice is to be approved. This procedure is termed stock watering and is generally looked upon with disfavor, except possibly in the case of a new corporation where stock is often necessarily issued to promoters for values not equivalent to its par value. If the corporation is in a position to pay a large dividend upon its stock at its present capitalization, there is a tendency to increase the capitalization without correspondingly increasing the actual value it represents, i.e., to water the stock. Obviously, the smaller percentage dividend paid as a result is likely to attract less attention to the large profits that have been earned. This practice is often criticized as being antagonistic to the best interests of the community. Some of the reasons for the objections are:

1. It is said to encourage higher prices than are necessary.
2. The ability to pay a fair dividend with a much smaller actual investment may attract other competing corporations to the field.
3. The issue of stocks and bonds for which no cash equivalent has been received is likely to deceive the uninstructed investors.

There is considerable difference of opinion as to whether stock watering creates the three economic conditions to which reference has been made. The vast discrepancy of opinion regarding the harmful effects of such a procedure and the general objection to any legislation that tends to curtail legitimate industrial expansion have greatly complicated this question. Much attention has been given this problem during the past two decades.

With regard to the first claim, that higher prices result from stock watering, it is argued that prices are the result of the law of supply and demand for a commodity and that the selling corporation will, under that law, secure as high a price for its product as the market will pay regardless of the profits and possible excessive dividends resulting therefrom. In short, the price will be set at the point of largest return possible from the sale of the product, quite independent of the capitalization of the company or the dividends paid upon the stock thereof. It is not the price, but the excessive dividend resulting from high prices, which is questioned. Equally high prices are possible with no stock watering. In the case of the public utility or quasi-public utility such as the water or light corporation which is furnishing a necessity to the public as a result of its monopoly or its preferential franchise granted by the state or municipality, there is more reason for limitation of both dividends and prices than in the case of the private business where free competition prevails.

The second claim in opposition to stock watering probably has considerable foundation in fact. It has been previously indicated that, when planning to incorporate a new enterprise, one of the subjects for preliminary investigation should be the prosperity and profits of companies already in the field. Large dividends paid upon overcapitalization would naturally indicate that the field was a fertile one for further cultivation by more conservative methods of investment in capital. It must be admitted, however, that supplies and costs of raw materials, manufacturing,

sales expenses, etc., are more vital subjects for study than the dividends of competitors. Even if competition and duplication of equipment are invited in some instances, it does not follow that overcapitalization should universally be throttled in the attempt to ward off such a condition. With the exception of public utilities, there is little to be said against such an effect if it should result. It is not the watering of the stock but the market conditions that result in large profits which are the source of the trouble.

It is probably true, when reference is made to the third argument against stock watering, that such a procedure tends to place upon the market and thence into the hands of misinformed investors many securities representing little or no actual cash or property equivalent. The removal of these from the market might counteract some of the undesirable results of stock speculation. However, if such prices are continually charged and such net profits earned that dividends of from 10 to 15 per cent and upward can be legitimately paid, it matters little whether the \$15 is paid annually as a 15 per cent dividend upon one share of stock whose market value is \$100, or as a 5 per cent dividend over each of three shares of stock at par. Again, it should be urged that the earning capacity measures the value of the stock and not its arbitrary and more or less fictitious par value.

In spite of these plausible arguments upon both sides of the question, a marked aversion to the practice of stock watering is abroad and conservative corporations are now tending to avoid the unsavory impressions upon the public which such a practice creates. This is especially true in the case of public utilities.

In many instances such watering of stock is prohibited by statute or by the charter or bylaws of the corporation. In the case of public utility corporations, over which commissions are now appointed in most states, capitalization is being limited to values closely approximating the appraised valuation of the property of the corporation. The watering of stock is, therefore, very largely eliminated. Gradually, in these cases, the watered stock issued previous to the formation of the commission is being made to represent true values, although this is a problem of difficult and tedious solution. One authority writes very conclusively upon the question of public utility capitalization control by states as follows:

The state which creates the municipal public utility and supervises its operation directly or through its agency, the municipality or commission, unquestionably has the power to regulate and control the issue of its stock, bonds, and other liabilities upon which a fair return for the service rendered may properly be expected. This matter is so easy of control in the hands of the state that its flagrant abuse in so many cases by the issue of almost unlimited quantities of watered stock is as difficult to understand as it is easy to correct or prevent. That the state has this power is beyond question, and, while some of the courts may seem inclined to sustain a rate which will permit of a return on such stock after it has been issued and purchased by third parties, there can be no question as to the opportunity or the duty of the state to prevent its issue in the first instance in the interest and for the protection of the public which pays for the service as well as purchases the securities. . . . There is an increasing tendency, however, to regulate the issue of stocks and bonds and a few of the states have clearly demonstrated that it is a simple matter indeed to prevent the issue of more stock or the creation of a greater bonded indebtedness than the value represented by it and received for it. When capitalization is an accurate valuation of the investment of a municipal public utility, the matter of its regulation is greatly simplified and the determination of the proper rate for the service rendered is greatly facilitated.¹

The problem of rate adjustment of public utilities will be discussed at greater length in another chapter.

2. How Much Capital Is Necessary?—Quite aside from the questions of overcapitalization and stock watering is that of estimating the legitimate needs of the new corporation in terms of *capital* with which to set up and carry on its business. This estimate is, of course, a technical problem for those to work out who are thoroughly familiar with the business and all its needs, particularly those needs required during the period of establishment of the corporation as a "going concern" before the revenue is available from the sale of its product. Although it is always more or less of a scientific guess for a newly organized corporation, yet executives who have had long experience in similar lines of business elsewhere should be able to arrive at the necessary capital by several different methods in order that one may be checked against another.

The questions of population of the city in which the product is to be sold, the probable percentage of sales or the demand for service per capita, the competition in sales, the cost of plant, raw

materials, labor, power, etc., must necessarily enter into a detailed estimate of the total capital required and the working capital needed at first.

The importance of accurate estimates of the investment needed and the probable earnings thereon has been previously mentioned. If the capitalization is greatly in excess of that needed, the management is unduly handicapped. Interest and dividends are expected upon this amount by bondholders and stockholders. If the funds cannot be efficiently and wisely invested so as to return a fair net income, these obligations cannot be met. If permitted to do so, the directors might invest the excess outside the business, but the return would probably not be in proportion to the interest and dividend demands made upon the capital of the corporation itself. More money may be expended than is actually necessary, but such a policy would soon reflect unfavorably upon the business ability and wisdom of the management. The capitalization might be reduced and the money returned to the stockholders, but again the business policy of the directors would be thrown open to criticism. Stockholders do not invest in order to have their money turned back to them, but rather look for a dividend therefrom greater than that available from investments of similar amounts elsewhere.

More serious, however, is the condition of capital shortage. Care should be exercised to make sure the estimates of necessary capital are sufficiently high. It is much easier to secure a little more capital when the campaign is on than it is to convince stockholders that more money must be invested in six months or a year to keep up the business. Stockholders cannot legally be called upon to invest in excess of the full-paid par value of their shares and, after this has been done and dividends thereon are expected, the stockholders are often unwilling either to vote an increase of capitalization or to take part in raising same if approved. It should be remembered also that the capitalization is stipulated in the charter and, in the case of public utilities, often approved by the public service commission of the state. The problem of securing permission for an early increase is, therefore, often a trying and tedious one which may lead to distrust and serious loss of credit.

3. Where Is the Capital Coming From?—Having decided upon the capital necessary and having applied for the desired capitali-

zation for the corporation, the final authorized capitalization is approved or determined by the state authority delegated by law for such a purpose. The third question then arises: Where is the money to come from? Three sources are usually available:

- a. Common stock.
- b. Preferred stock.
- c. Bonds.

The sale of stock, either preferred or common, should be immediately distinguished from the borrowing of money by means of a bond issue.* To state it differently, the stockholder should be recognized as a part owner in the business, while the bondholder is loaning money to the corporation, is therefore a creditor thereof, and may suddenly demand, in case of failure on the part of the corporation to pay interest upon the borrowed money represented by the bonds, a receivership, bankruptcy proceedings, mortgage foreclosure, or, indeed, all three.

In the case of a newly organized corporation with no tangible property with which to secure a bond issue, in the form of a mortgage, for example, the possibility of securing capital from a bond issue is negligible. In this respect corporations organized for different kinds of business vary widely in their bonding capacity. A mining corporation with a vast acreage of ore-bearing territory might issue bonds secured by property mortgage much more readily than a merchandising corporation doing business in a rented warehouse with its property changing in content and value from day to day. Among the public utilities, more property is generally available than with mercantile corporations; but, since the protection of a mortgage bond resides in the forced-sale value of the property in case of bankruptcy, this particular property may be found to be of little value apart from the going business of the utility itself. Similarly, a manufacturing corporation may have much of its capital in the form of a specially designed factory and raw materials of little general value in case of forced sale.

From the above considerations it will be seen that a bond issue is very seldom an available source of funds for the newly organized corporation unless particularly good security can be offered and bonds can be issued at a considerable discount. In some instances shares of common stock are given away as a premium

* See also Chap. III on Stocks, Notes, and Bonds.

with bonds in order to effect the sale of the latter. This is, of course, one form of stock watering. It is, however, rather difficult to promote a corporation without watering the stock to some extent initially.

If security is available for bonds, such an issue is generally preferable to preferred stock, for the interest obligation is less than the dividend required by the latter. A large issue of common stock, necessarily sold to many individual stockholders, may also be objectionable for it distributes too greatly the voting power and possibly the control of policy. A large body of stockholders clamoring for dividends upon common stock early in the career of the enterprise may be embarrassing to the directors.

4. How Much Should Be Furnished by Stockholders and How Much Should Be Borrowed?—In the case of the extension of the capital of a corporation already established, or the reorganization of a company having real estate or other security upon which to place a bond issue, the proper ratio between stocks and bonds is a very vital and sometimes very difficult question to determine.

Suppose, for example, that a capitalization of \$500,000 has been estimated as practical and assume that a 10 per cent *net return* seems assured upon the above investment. With some freedom of choice between different plans of financing, which should be adopted?

Plan I.—If bonds can be issued upon good security for \$300,000 at 6 per cent interest, the annual interest obligation is \$18,000, leaving \$32,000 of the net income with which to build up a reserve or, if desired by the directors, to pay a dividend upon preferred or common stock. The remainder of the capitalization, amounting to \$200,000, may be issued in the form of common stock to the promoters or incorporators, who thereby retain control of the company. Dividends are not ordinarily declared upon the common stock by the directors of newly organized corporations for the first few years, or at least until a surplus has been accumulated of sufficient size to guarantee a fairly stable annual dividend after it is once established. The net income in this example would, of course, be sufficient to pay a dividend of 16 per cent upon the stock; but a conservative policy would limit a dividend, if paid at all, to 8 or 10 per cent, setting the remainder aside as surplus.

Plan II.—However, it often happens that common stock cannot be sold readily in a new enterprise whose future is more or less uncertain. Preferred stock, usually provided with less security than bonds, would require a larger rate of interest in the form of a preferred dividend; possibly 7 per cent (for purpose of illustration) may be considered. Assume further that \$100,000 of the capital is provided by means of 7 per cent preferred stock and the remaining \$100,000 is issued as common stock to retain control of the company or is given away in part as a bonus to encourage the sale of bonds and preferred stock. The preferred-stock dividend would then be \$7,000 and the amount remaining for combined common stock and surplus would be reduced to \$25,000. This, in turn, represents a maximum possible dividend of 25 per cent upon the common stock as compared with 16 per cent in the first method of financing. The advantage of the stock donation, if permitted by statute and bylaws, is that, unlike the excess bond interest resulting from the sale of bonds at a discount, the dividend on donated common stock need not be declared by the directors until the corporate finances are well able to withstand the burden.

Plan III.—If, however, it is not possible to provide sufficient security for a bond issue, it may be necessary, although not always an ideal plan, to issue combined preferred and common stock. The preferred-stock portion should ordinarily be reduced to a minimum, since its dividend is fixed and the obligation rather great upon the new struggling corporation in its early years.

Most of the preferred stock issued now is cumulative, which requires the corporation to pay up, in subsequent years, accumulated dividends which may have been impossible of payment when due, before any dividend may be paid upon the common stock. This practice, while improving the marketability of the preferred stock, cripples the possibility of generous common-stock dividends. A further embarrassing feature of preferred stock from the standpoint of management of the company results from the fact that it is customary to provide no vote for the preferred stockholders so long as its dividends are paid, but sometimes to permit preferred stockholders to share in the voting as soon as a preferred-stock dividend is passed. This action may suddenly change the personnel of the voting body and seriously interfere with well-laid plans for the future development of the corporation.

It is usually necessary to offer more of a guarantee upon the investment than is forthcoming, particularly with a new company, from common stock alone. Preferred stock, at the lowest possible marketable dividend rate, is therefore often required.

Suppose the capitalization of this hypothetical corporation is made up of one-half preferred stock at 8 per cent dividend and the remainder of common stock. The preferred stock dividend will then require \$20,000 of the net income, leaving a possible maximum dividend of \$30,000 or 12 per cent for the common stock.

Thus we have the following summary of the three illustrative methods of providing for the \$500,000 capitalization of this company.

TABLE XX.—SUMMARY OF PLANS OF CAPITALIZATION
Plan I

Net income.....	\$50,000
Bonds \$300,000, 6 per cent.....	18,000

Common stock \$200,000, 16 per cent maximum dividend.....	\$32,000
Plan II	

Net income.....	\$50,000
Bonds \$300,000, 6 per cent.....	18,000
Preferred stock \$100,000, 7 per cent....	7,000

Common stock \$100,000, 25 per cent maximum dividend.....	\$25,000
Plan III	

Net income.....	\$50,000
No bonds.....	
Preferred stock \$250,000, 8 per cent.....	20,000

Common stock \$250,000, 12 per cent maximum dividend.....	\$30,000
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In the assumptions made of net income of 10 per cent or \$50,000 in the above problem, it should be noted that this is a rather generous estimate of return. Many corporations (public utilities, at least) never reach such a figure and few are likely to enjoy such returns over a period of years.

The minimum return in any year should therefore determine the bond issue if a choice of securities is available. A good rule is to limit the borrowed money on a bond issue to such an extent

that the interest on the bonds shall never exceed the net income under the most unfavorable conditions of business, and a ratio of 1:1 $\frac{3}{4}$ or 1:2 is a safer rule to follow if possible.

Public utility corporations, and especially steam railroads, have a very stable return as compared with industrials when considered over a period of several years; yet in the former interest obligations in excess of 20 per cent of their gross earnings should not be incurred unless absolutely necessary. This would mean an *operating ratio* of 80 per cent.* During the last two decades, many railroads, both electric and steam, have not only passed common- and preferred-stock dividends but have failed to earn bond interest, a failure that results in bankruptcy, mortgage foreclosures, and receiverships.

If, however, the interest on bonds can be kept down to 20 per cent of the gross revenue and the operating ratio can be reduced by good management to 70 per cent, this leaves a net income of 30 per cent or one and a half times bond interest. With an operating ratio of 60 per cent, leaving a net income of 40 per cent, the ratio of net income to bond interest is 2:1, which represents a very conservative management. A ratio of 1 $\frac{1}{2}$:1 is usually considered a considerable risk on the average, 1 $\frac{3}{4}$:1 fairly safe, and 2:1 a conservative estimate.

In connection with a prospective bond issue, it must be borne in mind that a new corporation with securities unestablished must sell its bonds at a lower figure and pay higher rates of interest than the older, well-accredited institutions. This condition favors a short-term redeemable bond. If the prospects are good, it will be desirable to retire such a bond issue in ten or twenty years, possibly at a premium, and refinance the corporation at such a later date with long-term bonds at lower interest rates. In contrast to this is the fact that the short-term bonds bring higher interest rates than those of long duration, other conditions being the same.

In cases where bonds do not find a ready sale, it may be necessary to offer shares of stock with the bonds as a premium, or to sell the bonds at a discount. The latter policy is equivalent, of

* "Operating ratio" (see Chaps. XXI and XXVII) has elsewhere been defined as the ratio of operating expenses to gross revenue. The question as to whether depreciation payments have been subtracted before operating expenses are used should always be stated.

course, to the payment of higher interest rates, with the further disadvantage that a prearranged bond issue results in a curtailed capital investment. Suppose, for example, that a bond issue of \$200,000 is decided upon, bearing 5 per cent interest. If it is found that these bonds must be sold at 80, the capital resulting from the sale will be \$160,000 and the interest paid thereon will be \$10,000 annually or $6\frac{1}{4}$ per cent. To this should be added an extra annual amount required to pay off the extra discounted value of the bonds at maturity. In this case, assuming a twenty-year bond, the additional annual obligation would be

$$\frac{\$40,000}{20} = \$2,000$$

per annum or $\$2,000/\$200,000 = 1$ per cent. Thus an equivalent interest would be $6\frac{1}{4} + 1 = 7\frac{1}{4}$ per cent.

When the small local corporation is seeking capitalization, the problem is less complex. Local investors, or possibly local banks, may be willing to absorb a bond or stock issue either because of acquaintanceship with the incorporators and their plans or because of local pride and desire to promote municipal prosperity.

Short-term notes may be resorted to by such corporations during the period of early financing. Trade credits secured as the result of past relations with the individual stockholders may permit the small corporation to obtain a ninety-day loan while doing its business upon a thirty or sixty-day basis. It must be borne in mind in this connection, however, that bankers and wholesale houses are less likely to extend credit to a corporation *per se* than to the same personnel engaged in a partnership enterprise. In the former case, the credit of an individual is of value to the creditor simply to the extent of that individual's investment in this particular corporation.

Many corporations are formed from partnerships or private individual lines of business. The capitalization of these is a comparatively simple matter. Property taken over by the corporation may be easily appraised and a conservative bond issue planned which is secured by a mortgage upon such property. Guaranteed interest securities, such as bonds and preferred stock, are usually issued in return for tangible property, while common stock is taken by interested parties who are willing to await the successful development of the business for their returns in the

form of dividends. These considerations therefore usually determine the proper ratio between bonded indebtedness and stock issues in such cases.

Employees are to a greater extent cooperating in new enterprises. In many cases this practice of making the employee an interested stockholder is tending to reduce industrial unrest and to educate the employee in the problems of finance and management. Disappointment often comes to the employee, however, from the realization that the individual stockholder has little to say regarding the management of the corporation although he does share its profits if, perchance, there are any. The sudden thwarting of the dreams of the idealist unaccustomed to management problems may produce a reaction unfavorable to the corporation, if the controlling vote is not carefully conserved by those experienced in and responsible for the management of corporate affairs.

Specific Reference

1. Pond, "Public Utilities," Bobbs-Merrill Company, Indianapolis, Ind.

General References

DEWING, ARTHUR STONE: "The Financial Policy of Corporations," Ronald Press Company, New York.

—: "A Study of Corporation Securities," Ronald Press Company, New York.

IGNATIUS, MILTON B.: "The Financing of Public Service Corporations," Ronald Press Company, New York.

LAGERQUIST, WALTER E., "Public Utility Finance," McGraw-Hill Book Company, Inc., New York.

RIPLEY, WILLIAM Z.: "Trusts, Pools and Corporations," Ginn and Company, New York.

SALIERS, EARL A.: "The Handbook of Corporate Management and Procedure," McGraw-Hill Book Company, Inc., New York.

Review Questions

1. Distinguish between capital and capitalization.
2. What is the ideal ratio between capitalization and capital and why is this ratio seldom constant?
3. If a corporation employs no-par stock exclusively, what is the ratio between capital and capitalization at all times?
4. Under what conditions does the market value of stocks indicate (a) overcapitalization; (b) undercapitalization?
5. What are the principal disadvantages to (a) overcapitalization; (b) undercapitalization?

6. What factors enter into the estimation of the amount of capital needed to launch successfully a new enterprise?
 7. What are some of the factors tending to fix the ratio between stock and bonds in financing a new enterprise?
 8. Classify the following ratios of net income to bond interest from very risky to very conservative: $1\frac{1}{2}:1$, $1:1$, $2:1$, $1\frac{3}{4}:1$, and $2\frac{1}{2}:1$.
 9. What advantage does a short-term redeemable bond have over the long-term bond in financing a new enterprise?
 10. What is the cost of capital in percentage of borrowed money to a corporation forced to issue 10-year \$1,000 par-value 5 per cent bonds at 85 per cent of par?
11. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively.
- T F Net income which is twice the interest on outstanding bonds represents a conservative business condition.
- T F Common-stock dividends usually fluctuate (in percentage of capitalization) more than preferred-stock dividends.
- T F The obligation to pay interest on bonds is more binding upon a corporation than the obligation to pay dividends on preferred stock.
- T F A recently organized small corporation, without physical plant or real estate, can usually issue bonds readily at a low interest rate.
- T F A long-term bond issue usually permits a lower interest rate than a note issue for the same corporation.
- T F The capitalization of a public utility corporation should approximate as closely as possible its valuation.
- T F Conservative financing requires that the preferred-stock dividend be earned at least $1\frac{1}{2}$ times after deducting the bond interest.
- T F A net income, after depreciation, which is $1\frac{3}{4}$ times bond interest, indicates a conservative safe management of a company of normal bond issue.
- T F Net income equal to bond interest is a satisfactory financial status for a company to attain.
- T F Not the par value but the earning power of a share of stock is the true measure of its value.

CHAPTER XIII

INTEREST, DISCOUNT, PRESENT WORTH, AND EQUIVALENCE

Too much attention cannot be concentrated by the engineer upon the calculation of interest. Notwithstanding the early study of this subject in the grade schools and in the everyday business world, few understand adequately its many important applications. Hence the apparent repetition of the initial basic principles of this subject.

Interest may be defined as "the consideration received or paid for the use of money for a period of time." It should be considered, more broadly, not only as *money received or paid* for the use of borrowed capital, but also that money which is earned by the productive investment of capital. The student and prospective businessman should realize that it is not necessary to borrow money to introduce problems involving the calculation of interest. Whenever an investment is made, whether it is for an automobile, a home, a bond, a share or more of stock, or a power plant, the interest must be charged against any such investment. If the investment had not been undertaken, the money thus made available would have earned its interest. Hence the interest is a fixed charge (proportional to money invested) and its proper accounting is quite as important as that for the proverbial taxes or insurance. The two latter may be avoided in some cases, but interest charges, never.

The factors involved in computing interest are: *principal, rate, and time.*

The *principal* is the sum of money upon which the interest is paid, or it may be considered as the amount of capital invested.

The *rate* is a ratio, expressed as a fraction or as a percentage of the principal. It is the ratio of the interest earned to the principal during a specified unit period of time.

The *time* is the period during which the principal is used. The *unit of time* is usually one year, although the day, the month, the

quarter, or the half-year may be used as a unit. Unless otherwise specified, the year is the unit of time assumed.

Two common forms of interest must be considered: simple and compound interest.

Simple interest is directly proportional to time. This is computed upon the original principal only and is usually due at stated intervals. If one is concerned only with the amount earned by the original principal in a given time and not with the productive reinvestment of such earnings, the investment is said to bear *simple interest*.

Thus with P = principal, i = interest rate, and n = number of interest periods, the simple interest is $I = Pni$.

Interest tables for ready reference, such as Table XXI, based upon this relation for 1 per cent interest rates or multiples thereof, are dependent upon a ratio applied to 365 days (in the exact calculation) or 360 days (12×30 in the ordinary calculation) in place of the time factor n for varying values of principal.

The *amount*, designated as S is the sum of principal and interest:

$$S = P + I = P(1 + ni)$$

Two methods of calculation of simple interest in which short-term indebtedness is reduced through partial payments at definite periods are in common use. They are known as the "merchant's rule" and the "United States rule." The former is the more rapid and simpler calculation while the latter is more exact, having acquired its name because of its formal approval by the U. S. Supreme Court.*

Merchant's Rule.—An example of this method is illustrated by the payment of a debt of \$7,500, incurred Jan. 1 and due on

Original debt.....	\$7,500.00
Interest on \$7,500 for 5 months.....	187.50
Less interest on \$2,500 for 4 months.....	\$50.00
Less interest on \$2,500 for $2\frac{1}{2}$ months.....	31.25
Less interest on \$1,500 for 1 month.....	7.50
	88.75
	98.75

Unpaid principal..... 1,000.00

Balance due June 1..... \$1,098.75

* *Woodward, Baldwin & Co. v. Daniel A. Jewell et al.*, 140 U.S. 247.

June 1 with interest at 6 per cent per annum, by making the following payments: \$2,500 on Feb. 1; \$2,500 on Mar. 15; \$1,500 on May 1, and the balance on June 1.

The *United States Rule* would be applied to the same situation as follows: Each installment is first applied against the interest due at the date the partial payment is made, and the balance of the installment is then applied to reduce the principal. Interest is always computed upon the reduced principal thus:

Original debt.....		\$7,500.00
Payment made Feb. 1.....	\$2,500.00	
Interest on \$7,500 for 1 month.....	37.50	2,462.50

		\$5,037.50
Payment made Mar. 15.....	\$2,500.00	
Interest on \$5,037.50 for 1½ months.....	37.78	2,462.22

		\$2,575.28
Payment made May 1.. ..	\$1,500.00	
Interest on \$2,575.28 for 1½ months....	19.31	1,480.69

		\$1,094.59
Interest on \$1,094.59 for 1 month.....		5.47

Balance due June 1.....		\$1,100.06

It should be noted that the latter method involves \$1.31 or 0.12 per cent more than the merchant's rule.

Legal interest is prescribed by the various states and will prevail unless the contracting parties specify a different rate. Thirty-three states, including Indiana, prescribe a legal rate of 6 per cent, while three, including the neighboring states of Illinois and Michigan, have a rate of 5 per cent as a minimum of all states and Alabama, Florida, Montana, and Utah have 8 per cent rates.

Lawful interest includes any interest rate up to the maximum prescribed by the state. Indiana allows a maximum rate of 8 per cent while other states vary from 7 per cent in Michigan and Illinois to "any rate parties may agree to" in at least four states.

In general, and in the absence of agreement, the law of the state where the contract is made governs the interest rate thereon.

If, however, a contract involving interest in one state is to be performed in another state, the law of the place of performance will govern unless the parties to the contract specifically agree to the contrary.

Compound Interest.—In the previous discussion which involved only simple interest, the principal upon which the interest was computed remained unchanged throughout the term of the loan. This simple interest became due either at the end of the term or at the end of stated intervals during the term of the loan. If not paid when due, the interest became simply a non-interest-bearing debt.

Frequently it is mutually agreed, in other types of transactions, that the interest for each period, instead of being paid when due, shall be added to and shall become a part of the principal. The interest is therefore computed upon a new principal which increases periodically. It is evident, therefore, that such interest for a given period will be more than that of the preceding period. Such interest, which is added to the principal at the end of each period is said to be *converted* into principal or *compounded*. The total amount due at the end of the last period is called the *compound amount*. The difference between the compound amount and the original principal is called the *compound interest*.

“Compound interest” may be legally defined therefore as: “Interest added to the principal as the former becomes due and thereafter made to bear interest.”* Compound interest is not favored by the courts and will not be allowed unless authorized by statute, or by contract, expressed or implied.†

In transactions involving simple interest paid at regular intervals, the creditor, collecting his interest and investing it at the same rate as the original loan, will accumulate new capital just as rapidly as if he had loaned the principal at compound interest originally.

Using the same nomenclature:

Interest for one period is Pi where ($n = 1$).

Amount at end of the first period (S) = $P(1 + i)$ or $P + Pi$.

Interest at end of second period = $i(P + Pi)$.

Amount at end of second period (S_2) = $P + Pi + i(P + Pi)$
= $P(1 + i)^2$.

* *Hovey v. Edmison*, 3 Dak. 449.

† *Timberlake v. First National Bank*, 42 Fed. 231.

Thus each unit of principal at the beginning of any period will accumulate $(1 + i)$ units at the end of the period, so that the total amount is obtained by multiplying the principal at the beginning of each period by $(1 + i)$. Since $P(1 + i)^2$ is the principal at the beginning of the third period, the amount at the end of the third period (S_3) will be $P(1 + i)^3$ and, by analogy, the amount at the end of n periods is $S_n = P(1 + i)^n$ or, more generally with h compounding periods in time n , $S_n = P \left(1 + \frac{i}{h}\right)^{hn}$.

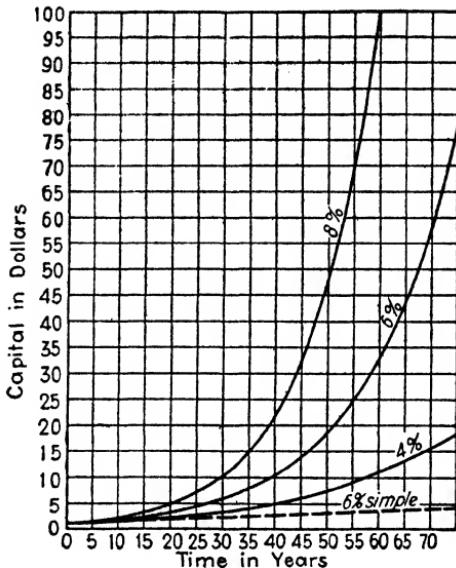


FIG. 25.—Compound amounts at various interest rates.

Taking logarithms of both sides of the general equation: $\log S_n = \log P + n \log (1 + i)$. If, for the sake of simplicity of the tables, the principal is taken as \$1 and the amount that \$1 of principal will accumulate in one period is represented by s , then $s_n = (1 + i)^n$ or $\log s_n = n \log (1 + i)$ or $s_n = \log^{-1} n \log (1 + i)$.

Thus, if the amount accumulated by \$1 during thirty years at annual compound interest of 4 per cent is desired, the expression would be $s_{30} = (\$1.04)^{30}$ or $\log s_{30} = 30 \log \$1.04$, whence $s_{30} = \$3.243$. Compounded semiannually, however, the expression is $s_{60} = (\$1.02)^{60} = \3.281 .

Since the amounts thus accumulated are proportional to the original principal involved, the values for \$1 in Table XXI, which have been calculated in a manner similar to that of the previous example, may be multiplied by any desired principal to determine the resultant amount at the end of any number of periods (n) and at any rate listed in the table. Thus the amount of \$15 at 4 per cent compounded annually for eight years is, from Table XXI, $S_8 = 15 \times \$1.369 = \20.53 .

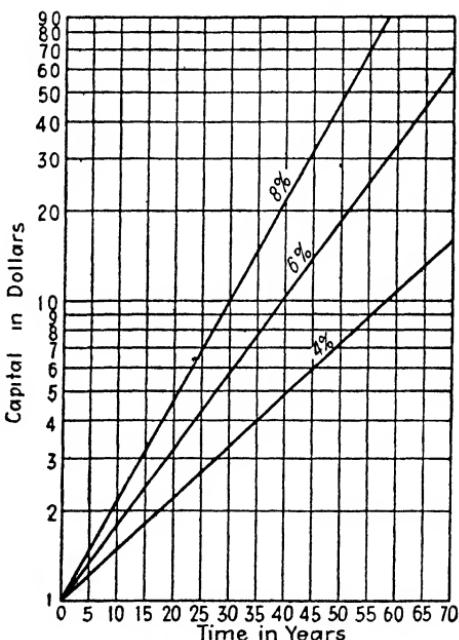


FIG. 26.—Compound amounts at various interest rates (logarithmic scale).

The graph for the amounts at *simple interest*, when plotted as ordinates against the number of interest periods as abscissas, will obviously be a straight line with a slope proportional to the interest rate.

The graph of the amount accumulated at *compound interest*, $S_n = P(1 + i)^n$, is an exponential curve concave upward which will intersect the simple-interest graph, plotted with the same coordinates, at the values of $n = 0$ and $n = 1$. If the compound amount is plotted to logarithmic ordinates with arithmetical abscissas, the curve becomes a straight line. These relations will be evident from Figs. 25 and 26, respectively.

Present Worth.—If P units of capital, placed at interest now at rate i , will amount to S_n units of capital in n periods, then a promise to pay S_n dollars in n periods is worth P dollars now; i.e., P is the *present worth* or *present value* of S_n . The *present time* is not necessarily involved, but a *definite prescribed time* may be used at which the cash value of an obligation is to be determined.

Present worth is sometimes called "present justifiable expenditure" or "capitalized value." It is obviously $P = \text{amount } S_n/s_n$ or the ratio of the total amount to the amount accumulated by

TABLE XXI.—COMPOUND-AMOUNT FACTORS

$$\text{Values} = (1 + i)^n = s^n$$

(Compound amount that a principal of \$1 will provide at the end of n periods with interest compounded each period)

n	4 per cent	5 per cent	6 per cent	7 per cent	8 per cent
1	1.040	1.050	1.060	1.070	1.080
2	1.082	1.103	1.124	1.145	1.166
3	1.125	1.158	1.191	1.225	1.260
4	1.170	1.216	1.262	1.311	1.360
5	1.217	1.276	1.338	1.403	1.469
6	1.265	1.340	1.419	1.501	1.587
7	1.316	1.407	1.504	1.606	1.714
8	1.369	1.477	1.594	1.718	1.851
9	1.423	1.551	1.689	1.838	1.999
10	1.480	1.629	1.791	1.967	2.159
11	1.539	1.710	1.898	2.105	2.332
12	1.601	1.796	2.012	2.252	2.518
13	1.665	1.886	2.133	2.410	2.720
14	1.732	1.980	2.261	2.579	2.937
15	1.801	2.079	2.397	2.759	3.172
16	1.873	2.183	2.540	2.952	3.426
17	1.948	2.292	2.693	3.159	3.700
18	2.026	2.407	2.854	3.380	3.996
19	2.107	2.527	3.026	3.617	4.316
20	2.191	2.653	3.207	3.870	4.661
25	2.666	3.386	4.292	5.427	6.848
50	7.107	11.47	18.42	29.46	46.90
100	50.50	131.5	339.3	867.7	2,200.

\$1. For n periods $P_n = 1/S_n$ and for the unit values of Table XXII involving only \$1, $p = 1/s$ and $p_n = 1/s_n$.

It will be noted that the values of present worth from Table XXII are, respectively, for the same interest rate and the same

number of periods, the *reciprocals* of corresponding amounts from Table XXI. Thus, for $n = 5$ periods at 6 per cent, Table XXII reads \$0.7473, which is the reciprocal of the corresponding \$1.338 of Table XXI. Similarly, the present worth of \$1,000, due five years hence at 6 per cent annually compounded interest, is $1000 \times 0.7473 = \$747.30$, or $\$1000/1.338 = \747.30 .

This reciprocal process to the determining of compound amount, wherein the present worth of a future amount due is calculated, is frequently called *discounting*; i.e., \$1,000 due in five years with 6 per cent annually compounded interest has a "discounted value" at present of \$747.30.

Equivalence.—It is frequently necessary to determine the present or cash values of a number of obligations *as of a definite*

TABLE XXII.—PRESENT WORTH OR DISCOUNT FACTORS

$$\text{Values} = \frac{1}{(1+i)^n} = \frac{1}{s^n} = \text{reciprocals of Table XXI}$$

(Present worth of \$1 due n periods hence, when interest is compounded at the end of each period)

n	4 per cent	5 per cent	6 per cent	7 per cent	8 per cent
1	0.9615	0.9524	0.9434	0.9346	0.9259
2	0.9246	0.9070	0.8900	0.8734	0.8573
3	0.8890	0.8638	0.8396	0.8163	0.7938
4	0.8548	0.8227	0.7921	0.7629	0.7350
5	0.8219	0.7835	0.7473	0.7130	0.6806
6	0.7903	0.7462	0.7050	0.6663	0.6302
7	0.7599	0.7107	0.6651	0.6227	0.5835
8	0.7307	0.6768	0.6274	0.5820	0.5403
9	0.7026	0.6446	0.5919	0.5439	0.5002
10	0.6756	0.6139	0.5584	0.5083	0.4632
11	0.6496	0.5847	0.5268	0.4751	0.4289
12	0.6246	0.5568	0.4970	0.4440	0.3971
13	0.6006	0.5303	0.4688	0.4150	0.3677
14	0.5775	0.5051	0.4423	0.3878	0.3405
15	0.5553	0.4810	0.4173	0.3624	0.3152
16	0.5339	0.4581	0.3936	0.3387	0.2919
17	0.5134	0.4363	0.3714	0.3166	0.2703
18	0.4936	0.4155	0.3503	0.2959	0.2502
19	0.4746	0.3957	0.3305	0.2765	0.2317
20	0.4564	0.3769	0.3118	0.2584	0.2145
25	0.3751	0.2953	0.2330	0.1842	0.1460
50	0.1407	0.0872	0.0548	0.0339	0.0218
100	0.0198	0.0076	0.0029	0.0012	0.0005

prescribed date, i.e., the present value at a specified (present) time. This determination of *equivalence* or equivalent (present) values is best illustrated by an example:

If money is worth 6 per cent and no interest is paid in the meantime, a debt of \$1,000 today can be cleared five years from now only by the payment of

$$\$1,000 (1.06)^5 = \$1,338 \text{ or } 1,000 \times 1.338 \text{ (Table XXI)} = \$1,338$$

Thus \$1,000 today is equivalent to \$1,338 five years hence.

Two years hence the equivalent is

$$\$1,000(1.06)^2 = \$1,124$$

One year ago the equivalent might have been

$$\frac{\$1,000}{(1.06)^1} = \frac{\$1000}{1.06} = \$943.40 \quad \text{or}$$

$$1000 \times 0.9434 \text{ (Table XXII)} = \$943.40$$

As another illustration, suppose one debt is to be discharged by the payment of \$1,000 one year hence and another debt is to be settled by the payment of \$1,500 in two years, both debts bearing 5 per cent annually compounded interest. What amount could be paid at the end of eighteen months to discharge both obligations at that time equitably?

$$\begin{aligned} x &= \text{equivalent} = \$1,000(1.05)^{0.5} + \$1,500(1.05)^{-0.5} \\ &= \$1,025.00 + \$1,463.40 \\ &= \$2,488.40 \end{aligned}$$

Thus, by collecting all the equivalent values or so-called present worths of a number of funds, due at various periods, a single equivalent total cash value may be determined for transformation into cash or for subsequent distribution in accordance with a definite law to be outlined in later chapters and for which convenient tables and graphical charts may be provided for simple calculation.

Review Problems

1. What will be the accrued simple interest on Nov. 10, 1937, on a note for \$1,000 at 6 per cent, payable annually, dated June 10, 1933? (Compute upon both a 30-day month and 365-day basis.)
2. Calculate, arithmetically, to three decimal places, the compound amount of \$1 at the end of the third year with 7 per cent annual interest compounded semiannually. (Check with Table XXI.)

3. Calculate, by means of logarithms, the compound amount of \$300 at 6 per cent compounded annually for 15 years. (Check with calculation using Table XXI.)

4. Calculate, arithmetically, to three decimal places, the present worth of \$1 due 3 years hence at 6 per cent interest compounded annually. (Check with Table XXII.)

5. Calculate, by means of logarithms, the present worth of \$400 due 15 years hence at 6 per cent interest compounded annually. (Check with calculation, using Table XXII.)

6. a. Calculate arithmetically the compound amount of \$1 at the end of the fourth year with 8 per cent interest compounded semiannually. Check with table.

b. Calculate by means of logarithms the compound amount of \$1 at 4 per cent per period for 8 periods. Check with table.

c. Determine, by means of the proper table, the compound amount of \$300 at the end of 5 years with 8 per cent interest compounded semiannually.

7. a. How much will a \$1,000 bank deposit be worth 5 years from now at 4 per cent compound interest?

b. At what cash value will a 10-year \$1,000 note, bearing 6 per cent compound interest, be discounted at the end of 9 years?

(Use tables for the following)

8. A 5 per cent account at the bank, compounded annually, will have a value of \$500 on Jan. 1, 1942.

a. What will be its worth on Jan. 1, 1938?

b. What will be its worth on Jan. 1, 1947?

9. Find the *total* of the present worths of the following compound interest accounts on Oct. 1, 1937:

a. Deposit of \$500 made on Oct. 1, 1927, at 4 per cent.

b. Note of \$1,000 matured on Oct. 1, 1932, at 6 per cent.

c. Note of \$1,500 due Oct. 1, 1937, at 7 per cent.

d. Note of \$2,000 due Oct. 1, 1937, at 5 per cent.

e. A bill of goods valued at \$300 delivered on Sept. 1, 1935, bearing interest at 6 per cent after the first 30 days.

10. *W* owes *Y* the following obligations (a) \$1,000 due at the end of 3 years, neglecting interest before maturity; (b) \$3,000 due at the end of 5 years with accumulated interest from today at 6 per cent compounded semi-annually. To discharge obligations (a) and (b) *W* paid \$1,000 at the end of 2 years, and one sum at the end of the third year and an equal sum at the end of the fourth year. Find these two unknown payments. Refer to a date 5 years hence.

CHAPTER XIV

ANNUITIES AND SINKING FUNDS

Various examples of the need of providing certain predetermined funds at some future date may be cited to illustrate practical engineering applications of the sinking-fund and annuity principles.

If such a fund is to be accumulated as the result of a single payment accumulating compound interest, a relatively large principal must be provided at the start, the larger principal being necessary, of course, with smaller interest rates. Thus, to provide a fund of \$10,000 at the end of ten years, compounded annually at 4 per cent (using compound interest only), the original principal must be

$$\frac{\$10,000}{(1.04)^{10}} = \frac{10,000}{1.48} \text{ (Table XXI)} \quad \text{or}$$

$$\$10,000 \times 0.6756 \text{ (Table XXII)} = \$6,756$$

Similarly, at 6 per cent interest the principal is

$$\frac{10,000}{(1.06)^{10}} = \frac{10,000}{1.791} \text{ (Table XXI)} \quad \text{or}$$

$$\$10,000 \times 0.5584 \text{ (Table XXII)} = \$5,584$$

Thus the curves representing the amounts in the fund during the intermediate years look something like Fig. 25, the steeper curvature during the latter years corresponding to the larger interest rate.

An *annuity* is the payment or receipt of a fixed sum of money at uniform intervals of time. Such annuity payments are usually made at the end of each period and are called ordinary annuities or annuities certain. The fund thus established is called a sinking fund. Payments, such as insurance premiums, which are paid in advance are called annuities due.

A sinking fund, which is a special form of annuity, is a fund built up during a period of time to provide a prescribed sum of money at the end of that period, by making at regular intervals

uniform deposits which draw compound interest. The interest rate, deposit interval, and size of deposit are so chosen as to make the sum of deposits, plus compound interest thereon, equal to the desired sum of money at the end of the specified period of time.

The determination of the amount of a sinking fund resulting from an annuity certain, consisting of payments made at the end of each of n years with all such payments bearing compound interest at the rate i , is made as follows for the general case:

Let s = amount of \$1 at compound interest for one period

$$= (1 + i) \quad \text{or} \quad s_n = (1 + i)^n = \left(1 + \frac{i}{k}\right)^{kn}$$

D = the deposit in dollars per period made at the end of each period.

k = the number of years in each period (for annual payments $k = 1$).

Z_n = summation of a series of all deposits with interest at end of n years which becomes the amount in dollars in the sinking fund.

Deposit 1, called D_1 , runs $(n - k)$ years and amounts to $D_1 s^{(n-k)}$ dollars.

Deposit 2, called D_2 , runs $(n - 2k)$ years and amounts to $D_2 s^{(n-2k)}$ dollars.

If all the deposits are equal, the summation of their amounts is the summation of the following geometrical series:

$$Z_n = D(1 + s^k + s^{2k} + \dots + s^{(n-2k)} + s^{(n-k)})$$

But the summation of such a series is

$$\frac{(\text{Last term} \times \text{ratio}) - \text{first term}}{\text{Ratio} - 1}$$

or, in this case,

$$Z_n = D \frac{s^{(n-k)} \times s^k - 1}{s^k - 1} = D \frac{s^n - 1}{s^k - 1} = D \frac{(1 + i)^n - 1}{(1 + i)^k - 1} = \\ D \frac{\left(1 + \frac{i}{h}\right)^{hn} - 1}{\left(1 + \frac{i}{h}\right)^{hk} - 1}$$

or, in the common case in which the deposit period and the interest periods are each one year ($k = h = 1$),

$$Z_n = D \frac{(1+i)^n - 1}{(1+i) - 1} = D \frac{(1+i)^n - 1}{i} = D \frac{s^n - 1}{s - 1}$$

If, at the end of each half-year for five years we deposit \$100 in the bank, and if 4 per cent interest is paid upon all such deposits and is compounded quarterly, what will be the amount at the end of the fifth year?

$$D = \$100 \quad n = 5 \quad k = 0.5 \quad i = 0.04 \quad h = 4$$

$$Z_5 = \$100 \left[\frac{(1.01)^{20} - 1}{(1.01)^2 - 1} \right] = \$1,100$$

By way of illustration of the tables, let us determine the amount produced in a sinking fund by an annuity certain resulting from the payment into the fund of \$500 at the end of each year for eight years with compound interest annually at 6 per cent. We have

$$s = 1.06; s^8 = s^8 = (\$1.06)^8 = \$1.594 \text{ from (Table XXI)}$$

$$z_8 \text{ (for } \$1\text{)} = \frac{s^8 - 1}{s - 1} = \frac{1.594 - 1}{0.06} = \$9.90 \text{ (Table XXIII = } 9.897)$$

$$Z_8 \text{ for } \$500 = \$500 \times 9.90 = \$4,950$$

Note, by comparison, that without interest accumulation $8 \times \$500 = \$4,000$; the compound interest on all the deposits would have amounted to \$950.00 during the eight years.

In Table XXIII will be found the amounts that \$1 will accumulate during various periods designated by n at the specified rates of compound interest.

Conversely, the process more frequently required is to determine the necessary annuity or deposit to establish a desired sinking fund after a given series of periods (n) has elapsed.

$$D = Z_n \left[\frac{\left(1 + \frac{i}{h}\right)^{hk} - 1}{\left(1 + \frac{i}{h}\right)^{hn} - 1} \right]$$

or, if $k = 1$ and $h = 1$,

$$D = Z_n \frac{s - 1}{s^n - 1}$$

Assume that it is desired to determine the proper annual deposit, bearing interest at 4 per cent, to provide \$100,000 in thirty years. Interest is compounded semiannually.

$$D = \$100,000 \left[\frac{\left(1 + \frac{0.04}{2}\right)^2 - 1}{\left(1 + \frac{0.04}{2}\right)^{60} - 1} \right] = \$1,754$$

If such a sum were to be produced with one initial payment accumulating compound interest at the same periods, it would

TABLE XXIII.—SINKING-FUND AMOUNTS

$$\text{Values} = \frac{(1+i)^n - 1}{i} = \frac{s^n - 1}{s - 1} = \frac{s^n - 1}{i}$$

(Summation of the series throughout n periods of \$1 deposits made at the end of each period, with interest compounded at the end of each period)

n	4 per cent	5 per cent	6 per cent	7 per cent	8 per cent
1	1.000	1.000	1.000	1.000	1.000
2	2.040	2.050	2.060	2.070	2.080
3	3.122	3.153	3.184	3.215	3.246
4	4.246	4.310	4.375	4.440	4.506
5	5.416	5.526	5.637	5.751	5.867
6	6.633	6.802	6.975	7.153	7.336
7	7.898	8.142	8.394	8.654	8.923
8	9.214	9.549	9.897	10.260	10.64
9	10.580	11.030	11.490	11.980	12.49
10	12.006	12.580	13.180	13.820	14.49
11	13.49	14.21	14.97	15.78	16.65
12	15.03	15.92	16.87	17.89	18.98
13	16.63	17.71	18.88	20.14	21.50
14	18.29	19.60	21.02	22.55	24.21
15	20.02	21.58	23.28	25.13	27.15
16	21.82	23.66	25.67	27.89	30.32
17	23.70	25.84	28.21	30.84	33.75
18	25.65	28.13	30.91	34.00	37.45
19	27.67	30.54	33.76	37.38	41.45
20	29.78	33.07	36.79	41.00	45.76
25	41.65	47.73	54.86	63.25	73.11
50	152.7	209.3	290.3	406.5	573.8
100	1,238.	2,610.	5,638.	12,382.	27,485.

require, as previously explained, under compound interest

$$P = \frac{S}{\left(1 + \frac{i}{h}\right)^{hn}} = \frac{\$100,000}{(1.02)^{60}} = \frac{100,000}{3.28} = \$30,450$$

For convenience in the more simple calculations, the values of Table XXIV will be found as reciprocals, respectively, of the corresponding values of Table XXIII. Thus, if \$100,000 were to be produced in twenty-five years with equal annual payments bearing annual compound interest at 4 per cent,

$$P_{25} = \$100,000 \times 0.024 \text{ (Table XXIV)} = \$2,400 \text{ per annum}$$

or, using Table XXIII,

$$P_{25} = \frac{\$100,000}{41.65} = \$2,400 \text{ per annum}$$

A fund of \$10,000 may be accumulated in ten years by means of annual compound interest alone at 4 per cent only by an initial investment of \$10,000/1.48 (Table XXI) or

$$10,000 \times 0.6756 \text{ (Table XXII)} = \$6,756$$

Thus, it will be seen that compound interest alone without the annuity payment feature ties up a large principal during the whole of the period, thus placing such a method at a disadvantage when compared with the sinking fund. Thus, to provide the same amount (\$10,000) by means of ten year-end payments,

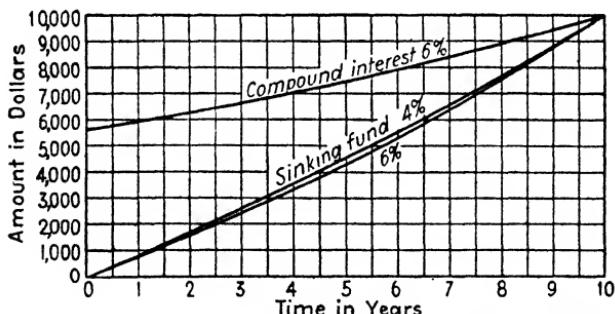


FIG. 27.—Compound interest and sinking funds to produce \$10,000 in 10 years.

each bearing 4 per cent compound interest, the initial and all subsequent annual payments are only

$$\$10,000 \frac{s - 1}{s^n - 1} \text{ (Table XXIV)} = 10,000 \left[\frac{0.04}{1.04^{10} - 1} \right] = \\ 10,000 \times 0.0833 = 833.00$$

Or, if such a fund may be made to bear 6 per cent compound interest, we have an annual payment of only

$$\$10,000 \left[\frac{0.06}{1.06^{10} - 1} \text{ (Table XXIV)} \right] = \$10,000 \times 0.0759 = \$759$$

Here again the amounts in the fund accumulate relatively rapidly during the later years with the higher interest rates. The graphs of these three methods of raising \$10,000 in ten years are shown in Fig. 27, in which the amounts in the sinking funds are determined by applying Table XXIII.

Such funds may be set up to provide replacement for the depreciation or obsolescence of equipment; to secure insurance protection at some future time, either in the form of a lump

TABLE XXIV.—ANNUAL PAYMENT FACTORS FOR SINKING FUNDS

$$\text{Values} = \frac{i}{(1+i)^n - 1} = \frac{s-1}{s^n - 1} = \text{reciprocals of Table XXIII}$$

(Deposit necessary to be made at the end of each of n periods to provide \$1 after n deposits have been made, compounded at the end of each period)

n	4 per cent	5 per cent	6 per cent	7 per cent	8 per cent
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.4902	0.4878	0.4854	0.4831	0.4808
3	0.3203	0.3172	0.3141	0.3111	0.3080
4	0.2355	0.2320	0.2286	0.2252	0.2219
5	0.1846	0.1810	0.1774	0.1739	0.1705
6	0.1508	0.1470	0.1434	0.1398	0.1363
7	0.1266	0.1228	0.1191	0.1156	0.1121
8	0.1085	0.1047	0.1010	0.0975	0.0940
9	0.0945	0.0907	0.0870	0.0835	0.0801
10	0.0833	0.0795	0.0759	0.0724	0.0690
11	0.0741	0.0704	0.0668	0.0634	0.0601
12	0.0666	0.0628	0.0593	0.0559	0.0527
13	0.0601	0.0565	0.0530	0.0497	0.0465
14	0.0547	0.0510	0.0476	0.0443	0.0413
15	0.0499	0.0463	0.0430	0.0398	0.0368
16	0.0458	0.0423	0.0390	0.0359	0.0330
17	0.0422	0.0387	0.0354	0.0324	0.0296
18	0.0390	0.0355	0.0324	0.0294	0.0267
19	0.0361	0.0327	0.0296	0.0268	0.0241
20	0.0336	0.0302	0.0272	0.0244	0.0219
25	0.0240	0.0210	0.0182	0.0158	0.0137
50	0.0068	0.0048	0.0034	0.0025	0.0017
100	0.0008	0.0004	0.0002	0.0001	0.0000

sum or an annuity payment; to furnish some new building or extension to present property which may be anticipated by the extrapolation of population or business increase trend curves; or to refund some bond issue that may be maturing at a pre-determined date in the future.

As an example of a depreciation fund: A motor-generator frequency-changer set in a power station of 2000 kva. rating cost \$30,000 and is estimated to have a life of twenty years; at the end of this time it may be expected to have a salvage or junk value of \$600. To replace this machine at the end of its life, a fund of \$29,400 must be provided in twenty years. If so-called straight-line depreciation is assumed, i.e., if equal annual decreases in value are expected to take place with no interest accumulation upon the fund, the annual charge to a depreciation reserve would be $29,400/20 = \$1,470$. If, however, a sinking fund is set up to provide for this replacement on a 6 per cent basis, the annual obligation would be

$$\$29,400 \left[\frac{0.06}{1.06^{20} - 1} \text{ (Table XXIV)} \right] = \\ \$29,400 \times \$0.0272 = \$799.68$$

The amount in the fund at any intermediate year is, of course, determined from the summation of Table XXIII at the same interest rate, 6 per cent; e.g., at the mid-period, instead of $29,400/2 = \$14,700$ in the fund, as would be the case for straight-line depreciation, there is only

$$\$800 \left[\frac{1.06^{10} - 1}{0.06} \text{ (Table XXIII)} \right] = \$800 \times 13.18 = \$10,544$$

The important feature demonstrated is the low obligation during the early years of a high-interest-rate sinking fund.

Useful modifications of these equations result in the following:

To find the present worth of any fund, it is necessary only to multiply it by the proper value from the discount Table XXII or to divide by s^n (Table XXI) $w_n = \frac{s^n - 1}{(s - 1)s^n}$. This calculation, for a sinking fund previously developed and expressed as a formula, gives W_n as the present worth of such a sinking fund. The factors for \$1 at various rates of interest and values of n periods are given in Table XXV.

Referring to the motor-generator set, for which the amount of \$29,400 is to be accumulated in twenty years, the present worth of such a fund at the time it is first established as a 6 per cent compound-interest obligation is

$$\$29,400 \times 0.3118 \text{ (Table XXII)} = \$9,170$$

However, since Table XXV, for convenience, has been calculated as a combination of Tables XXIII and XXII, the same present worth may be at once determined from the annual deposit of $\$799.68 \times 11.47$ (Table XXV) = \$9,170.

Similarly, if a given present fund is to be distributed in n annuity payments, with the remainder of the fund bearing compound interest throughout the period, it is necessary only to use the reciprocal of the previous expression or

$$a_n = \frac{s^n(s - 1)}{s^n - 1}$$

from Table XXVI.

As an illustration of such annuity payments, available from a given sum of money in hand, which are to be made subsequent to the accumulation of such a sum, suppose an insurance policy has matured at a value of \$10,000 and provision has been made to have such a sum paid in twenty equal installments over a period of twenty years, with the balance bearing 6 per cent interest. The annual payment from \$1, exclusive of insurance-company service costs and profits, would therefore be

$$\frac{1.06^{20}(1.06 - 1)}{1.06^{20} - 1} = \$0.0872 \text{ (Table XXVI)}$$

From \$10,000 the payment would be

$$10,000 \times 0.0872 = \$872$$

Obviously, this table is reciprocal to Table XXV and conversely $\$872 \times 11.47$ (Table XXV) = \$10,000.

Furthermore, combining Tables XXV and XXIV, if an annuity of \$1,200 is to be paid to the insured from a fund bearing 4 per cent interest for a ten-year period after the necessary value has been established with equal annual payments during a fourteen-year period with 5 per cent interest, the amount necessary for

the annuity fourteen years hence would be

$$\$1,200 \left[\frac{1.04^{10} - 1}{1.04^{10} \times 0.04} \right] = \$1,200 \times 8.11 = \$9,740$$

TABLE XXV.—PRESENT-WORTH FACTORS FOR SINKING FUNDS

$$\text{Values} = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{s^n - 1}{s^n(s - 1)} = \text{Table XXIII} \times \text{Table XXII} = \text{approx.}$$

$1/i$ for large values of n

(Present or discounted value of the sinking fund of Table XXIII)

n	4 per cent	5 per cent	6 per cent	7 per cent	8 per cent
1	0.9615	0.9524	0.9434	0.9346	0.9259
2	1.886	1.859	1.833	1.808	1.783
3	2.775	2.723	2.673	2.624	2.577
4	3.630	3.546	3.465	3.387	3.312
5	4.452	4.329	4.212	4.100	3.993
6	5.242	5.076	4.917	4.767	4.623
7	6.002	5.786	5.582	5.389	5.206
8	6.733	6.463	6.210	5.971	5.747
9	7.435	7.108	6.802	6.515	6.247
10	8.111	7.722	7.360	7.024	6.710
11	8.760	8.306	7.887	7.499	7.139
12	9.385	8.863	8.384	7.943	7.536
13	9.986	9.394	8.853	8.358	7.904
14	10.56	9.899	9.295	8.745	8.244
15	11.12	10.38	9.712	9.108	8.559
16	11.65	10.84	10.11	9.447	8.851
17	12.17	11.27	10.48	9.763	9.122
18	12.66	11.69	10.83	10.06	9.372
19	13.13	12.09	11.16	10.34	9.604
20	13.59	12.46	11.47	10.59	9.818
25	15.62	14.09	12.78	11.65	10.67
50	21.48	18.28	15.76	13.80	12.23
100	24.50	19.85	16.62	14.27	12.49

The annual payment necessary to produce \$9,740 at the end of fourteen years with 5 per cent interest is

$$\$9,740 \left[\frac{0.05}{1.05^{14} - 1} \right] = \$9,740 \times 0.0510 = \$496$$

Not considering interest, it would require \$9,740/14 = \$695.

Suppose a telephone company expects to have to install a new underground cable in ten years to meet certain extrapolated traffic demands. The cost is estimated to be \$50,000. Having

budgeted this for ten years on a 5 per cent basis, it is found to be necessary to install the cable at a date five years from the begin-

TABLE XXVI.—ANNUITY FACTORS

$$\text{Values} = \frac{i(1+i)^n}{(1+i)^n - 1} = \frac{s^n(s-1)}{s^n - 1} = \text{reciprocals of Table XXV and also} =$$

Table XXI \times Table XXIV

(Annuity or equal payments which may be made at the end of each of n periods from \$1, in hand at present, with interest compounded at the end of each period)

n	4 per cent	5 per cent	6 per cent	7 per cent	8 per cent
1	1.0400	1.0500	1.0600	1.0700	1.0800
2	0.5302	0.5378	0.5454	0.5531	0.5608
3	0.3603	0.3672	0.3741	0.3811	0.3880
4	0.2755	0.2820	0.2886	0.2952	0.3019
5	0.2246	0.2310	0.2374	0.2439	0.2505
6	0.1908	0.1970	0.2034	0.2098	0.2163
7	0.1666	0.1728	0.1791	0.1856	0.1921
8	0.1485	0.1547	0.1610	0.1675	0.1740
9	0.1345	0.1407	0.1470	0.1535	0.1601
10	0.1233	0.1295	0.1359	0.1424	0.1490
11	0.1141	0.1204	0.1268	0.1334	0.1401
12	0.1066	0.1128	0.1193	0.1259	0.1327
13	0.1001	0.1065	0.1130	0.1197	0.1265
14	0.0947	0.1010	0.1076	0.1143	0.1213
15	0.0899	0.0963	0.1030	0.1098	0.1168
16	0.0858	0.0923	0.0990	0.1059	0.1130
17	0.0822	0.0887	0.0954	0.1024	0.1096
18	0.0790	0.0855	0.0924	0.0994	0.1067
19	0.0761	0.0827	0.0896	0.0968	0.1041
20	0.0736	0.0802	0.0872	0.0944	0.1019
25	0.0640	0.0710	0.0782	0.0858	0.0937
50	0.0466	0.0548	0.0634	0.0725	0.0817
100	0.0408	0.0504	0.0602	0.0701	0.0800

ning of the fund. How much extra cash is required to carry out the project at the earlier date?

$$\$50,000 \left[\frac{0.05}{1.05^{10} - 1} \text{ (Table XXIV)} \right] =$$

$$\$50,000 \times 0.0795 = \$3,975 \text{ per year}$$

At the end of five years the amount is

$$\$3,975 \left[\frac{1.05^5 - 1}{0.05} \text{ (Table XXIII)} \right] = \$3,975 \times 5.526 = \$22,000$$

$\$50,000 - \$22,000 = \$28,000$ must be supplied in cash at the end of five years.

Another example of the convenience of such sinking-fund tables is the so-called capitalization of certain present annual operating expenses which may be avoided by some estimated capital expenditure. The elimination of a grade crossing on a railroad which may do away with the necessity of the crossing watchman and certain average annual accident expenses, or the replacement of manually operated equipment in a substation or telephone exchange can be either justified or proved uneconomical by means of the calculation of capitalized operating expense.

Possibly a saving of \$2,000 per annum may be made in the operating expense owing to the purchase of a more expensive power-station step-up transformer having a higher efficiency than the one considered or that installed at present. Capitalized at 6 per cent over the probable life of the transformer of twenty years, the amount of present losses may be expressed as the *present worth* of a series of twenty expense items of \$2,000 each, in round numbers thus:

$$\$2,000 \left[\frac{1.06^{20} - 1}{1.06^{20}(0.06)} \left(\text{Table XXV or } \frac{1}{\text{Table XXVI}} \right) \right] = \frac{2,000}{0.0872} = \$23,000$$

A special case of such so-called capitalization of operating expenses, in which the improvement to be undertaken is supposed to substitute for the *permanent* elimination of such annual payments, deserves especial attention. It should be noted, for example, that the values of Table XXVI which provide the denominator of the previous calculation decrease markedly with increased values of n and approximate as a limit the interest rate. This result is more pronounced, of course, with the higher rates of interest; e.g., the 8 per cent column of Table XXVI reaches the value 0.0800 when $n = 100$ years. Inspection of the previous problem also shows that $\frac{1.06^{20} - 1}{1.06^{20}(0.06)}$ (Table XXV) may be

written $\frac{1.06^{20}}{1.06^{20}(0.06)} - \frac{1}{1.06^{20}(0.06)}$ or $\frac{s^n}{s^n(s - 1)} - \frac{1}{s^n(s - 1)}$, for which the second term becomes negligibly small as n increases and approaches $1/0.06$ as its limit or $1/i$ for any interest rate i .

Thus it may be stated that a permanent improvement may have a capitalized value of $\frac{\text{Saving in annual expense}}{\text{Interest rate}}$.

A railroad grade improvement, considered as a permanent improvement which saves annually the salary of watchmen of \$2,000 would be capitalized at $\$2,000/0.05 = \$40,000$ if money can be borrowed at a 5 per cent interest rate.

One additional comment upon the sinking-fund series may be pertinent. The question naturally arises: "How would this series be changed and how would the amount accumulated be increased if the payments were made at the beginning rather than at the end of each period?" Inspection should point to the fact that one additional year's interest would be added to the summation of the series. Duplicating the detailed statement of such a series for a more rigid proof thereof, the expression, with $k = 1$, becomes:

$$Z_n = D[s + s^2 + s^3 + \dots + s^{n-1} + s^n] = \\ D \frac{s^n - s}{s - 1} = D \frac{s(s^n - 1)}{s - 1} = D \times s \times \frac{s^n - 1}{s - 1}$$

But since $S = 1 + i$,

$$Z_n = D \frac{s^n - 1}{s - 1}(1 + i)$$

This will be recognized as the summation of the former sinking-fund series multiplied by the amount for one extra year or the addition of one extra year of interest.

Calculations similar to those herein described are found very convenient in determining the annual obligations which must be undertaken to provide for the payment, at the future date of maturity, of money borrowed upon bond issues. Such processes, classified as the refunding or amortization of bond issues, will be considered as a special case of sinking funds in the next chapter.

Review Questions

1. The life of a large substation storage battery which cost \$10,000 is estimated to be 9 years and it is assumed that it has no value thereafter. What equal payments should be made at the end of each of the 9 years of its life to replace it at the same cost when it is worn out? Consider the fund to bear 6 per cent compound interest.
2. A fund is being provided to replace a telephone cable in 10 years which is estimated to cost \$50,000. Annual appropriations to this fund accumulate

at compound interest at 4 per cent. It is found, at the end of 7 years, that the cable must be replaced at once at the estimated expense. How much cash must be provided at that time in addition to the amount then in the fund?

3. Twenty years from now Mr. A plans to retire on a 20-year, \$2,000, 5 per cent annual annuity created by investing the annual profits from the sale of certain objects of art made in his spare time. These objects net a profit of \$10 each. How many of these objects will he have to sell annually, if he has available a source of 5 per cent annual compound interest for all his investments?

4. a. A father borrows \$2,000 from a bank in order to send his son to college, promising to pay \$2,000 plus all 5 per cent interest accumulations compounded annually at the end of 10 years. How much will the father pay?

b. Suppose the father, after 4 years, started paying into a sinking fund in order to pay off his obligation. Twelve equal payments were to be made semiannually. Interest is 8 per cent compounded semiannually. What semiannual deposit should be made?

5. Mr. and Mrs. A decide to provide for the education of their daughter by means of ten equal annual payments to a fund which will pay back four equal annual installments of \$1,500 each. If all funds and balances bear an annual 5 per cent compound interest, what annual deposits will they have to make?

6. A man at the age of thirty wishes to start accumulating a fund by annual deposits at 5 per cent which 20 years later will pay him twenty annual equal payments of \$2,000 each. If the money accumulated in the first 20 years is invested at 8 per cent during the last 20 years, what will the man's deposit have to be during the first 20 years?

7. What is the *total present value* of all your following accounts, all of which bear interest at 4 per cent compounded annually:

a. A deposit of \$1,500 made two years ago?

b. An agreement which you made to pay \$50 per annum for the next 10 years?

c. A contract in which you agree to guard a railroad crossing for 5 years at a salary of \$1,500 per year?

d. A 4 per cent \$1,000 (face value) bond maturing in 10 years?

8. The creditor, to whom the following funds are to be due at the various dates indicated, is obliged to raise cash to the amount of \$4,500 at once.

(a) Will the present worth of the funds suffice? (b) Calculate the excess or shortage to be made up as the case may be:

(1) A note of \$2,000 maturing 3 years hence, bearing 5 per cent interest annually (interest reinvested at 6 per cent annually).

(2) A bill of goods, sold 1 year ago, amounting to \$1,200, upon which quarterly compound interest at 8 per cent annually is to be collected.

(3) A bond of \$1,000, maturing 10 years hence, bearing 5 per cent interest, purchased last week at a price to yield 6 per cent.

9. What is the net worth as of today of a company that has the following assets and liabilities:

- a. A 5 per cent sinking fund started 7 years ago with annual deposits of \$2,000.
 - b. An obligation for this company to pay \$1,000 annually for the next 10 years, with money worth 6 per cent.
 - c. A bank deposit of \$10,000 made 5 years ago at 4 per cent.
 - d. Physical property estimated to have a value of \$100,000 today.
 - e. An obligation for this company to pay \$4,000 two years hence with money worth 7 per cent.
10. Upon the death of a rich uncle a young man falls heir to the following:
- a. A bank deposit of \$50,000 with accumulated 4 per cent compound interest for the past 5 years.
 - b. A house having a certified value of \$10,000, upon which there is an obligation to pay \$500 every 6 months for 5 more years (interest at 6 per cent compounded semiannually).
 - c. Ten \$1,000 bonds (par value) drawing \$50 interest each per year and with 10 years to mature (consider the market rate of money at 6 per cent compounded annually).
 - d. His uncle's obligation to pay a church the sum of \$300 annually forever. Market rate of money 6 per cent compounded annually. What is the combined present worth of this legacy?
11. What is the present worth of each of the following items of party *A*?
- a. A sinking fund earning 5 per cent compound interest started 15 years ago with an annual deposit of \$500 and continued for 10 years, at which time the annual deposits were discontinued but the accumulated amount left at 5 per cent compound interest.
 - b. A contract from which *A* is to receive \$20,000 a year for the next 10 years with money worth 6 per cent.
 - c. Ten \$1,000, 5 per cent par-value bonds maturing 10 years hence, purchased 10 years ago, to yield 7 per cent on the investment.
 - d. A fruit orchard which is estimated to yield \$10,000 a year for 10 years, starting 10 years from now when money is worth 6 per cent?
12. The installation of an automatic substation, with a life of 20 years, eliminates the services of four operators whose wages total \$6,000 per annum. With money worth 6 per cent per annum and sinking-fund depreciation figured at 6 per cent compound interest, how large an initial investment in the new substation would be warranted as the result of the saving in wages?
13. A certain utility has transformer burnouts amounting to \$10,000 a year. A certain manufacturer recommends his new transformer equipped with three-point protection against lightning. Assuming 75 per cent of the burnouts will be prevented, that the life of the new transformers is 20 years, and that money is worth 5 per cent, what can the utility afford to pay for the new transformers?
14. A certain light and power company estimates that the installation of automatic meter-reading and billing equipment costing \$100,000 will save the salary of ten clerks. If the salary of two clerks represents the depreciation and maintenance costs of the new equipment and a clerk's annual salary is \$1,500, will it pay to purchase this equipment (*a*) if it has a life of 10 years; (*b*) if it has a life of 12 years with money at 5 per cent? Why?

15. A certain central station has 10,000 city meters and 3,000 rural meters. It costs 2 cts. per meter to read the city meters once a month and 12 cts. per meter to read the rural meters once a month. If money is worth 6 per cent, what could you afford to pay in a lump sum for remote reading equipment which would dispense with all meter readers?

16. A certain lumber company borrows \$100,000 at 5 per cent interest to reforest a tract of land with trees that take 20 years to mature to a size suitable for lumber. On another tract of land, they own standing timber which yields an average profit of 5 cts. a running foot for all lumber cut, milled, and sold. How many feet of lumber will they have to sell each year if half the profits are used to pay the interest on, and retire the principal of, the above loan by the time the new trees are ready to cut, if 5 per cent compound interest is available to them?

17. An office building was leased to a building corporation by the owner on a 99-year lease for a rent of \$6,000 a year. What lump sum could the owner have accepted originally in lieu of the 99-year lease if money is worth $4\frac{1}{2}$ per cent?

18. What amount should be included in a valuation of a public utility for a 20-year paid-up lease of an office building if this building can be rented for \$4,800 per annum? Money is worth 7 per cent compounded annually.

19. What amount should one pay now for a house in lieu of a \$600 annual rental if the house is to be used 20 years and money is worth 7 per cent?

20. A house was built, costing \$10,000, and was mortgaged for \$6,000. The owner agreed to pay an equal amount on the mortgage each year in such a manner that it would be entirely paid (with 3 per cent compound interest each year on the balance due) in 10 years.

a. What was this annual obligation?

b. How much would the owner have to pay in cash at the end of the fifth year in order to clear the mortgage?

21. Ten years ago Mr. A bought a house for \$8,000. Taxes, insurance, and upkeep have cost him \$272 per year. He has received \$600 per year rent, which, after deducting the yearly expenses, he placed in the bank at 6 per cent. Mr. A wishes to sell the house now at a figure that is equivalent to 6 per cent return on his investment.

a. Calculate the selling price of the house.

b. Mr. A takes all the money available from the above investment and purchases a four-year 6 per cent annuity for the schooling of his two sons. How much does each son get each year end for 4 years?

22. A purchaser of a new automobile, which cost \$2,000, made a down payment of \$500 and contracted to pay the remainder in 5 equal installments paid quarterly bearing 8 per cent annual interest compounded quarterly. What is the necessary quarterly payment?

23. A bank proposes to loan money to a man who offers to give title to a gravel pit of indefinite capacity as security for the loan. The bank wishes to loan money up to 50 per cent of the present worth of the pit. If \$35,000 worth of gravel is sold each year and \$25,000 expense is incurred in removing

this gravel, how much money can the bank loan if all moneys are at 7 per cent?

24. You receive a legacy of \$8,600. You are offered ten first-mortgage high-grade 5 per cent bonds, par value \$1,000, at \$860 each, maturing in 10 years, or you have a chance at a second mortgage on a fraternity house for \$8,600, paying 7 per cent. Which would you choose and why?

25. A man wishes to obtain an income of \$500 a year for 20 years by setting aside a lump sum at the present time. Compare the following three possibilities as to initial outlay and final result, including the relative advantages and disadvantages of each:

- a. A savings bank paying 4.5 per cent simple interest.
- b. Ten \$1,000, 20-year government bonds paying 5 per cent simple interest priced at \$950 each.
- c. An annuity bearing 5 per cent interest compounded annually.

CHAPTER XV

INSURANCE, BOND INTEREST, AND AMORTIZATION

Having developed the basis for the six tables which are fundamental for the calculation of compound interest, discount, sinking funds, and annuities, it is appropriate that their application to insurance, as well as to the treatment of yield and bond-amortization problems, should be considered. The establishment of similar funds for the replacement of equipment subject to depreciation has been presented in Chap. X.

Insurance Annuities.—Any form of insurance, but particularly endowment life insurance, due the insured or his estate, may be arranged for payment, from the fund accumulated, in the form of a prescribed number of equal annual, semiannual, quarterly, or monthly amounts, the balance remaining in the fund and accumulating compound interest during the period in which the payments are being made.

For example, suppose that \$10,000 is due the insured upon a particular date of maturity, say, Jan. 1, 1937; arrangements may be made to pay this to the insured in twenty equal annual payments, the balance in the fund bearing compound interest at 6 per cent. The fund of \$10,000 becomes the *present worth* or *value* upon Jan. 1, 1937, of an annuity which may be calculated as follows:

$$\text{Table XXVI is: } \frac{s^n(s - 1)}{s^n - 1} \text{ or } \frac{1.06^{20}(1.06 - 1)}{1.06^{20} - 1} = \$0.0872$$

Stated concretely, this means that 8.72 cts. might be paid from \$1 of present value during each of twenty years if the balance in the fund were, in the meantime, accumulating compound interest at 6 per cent.

For \$10,000 the annuity is $\$10,000 \times 0.0872 = \872 .

However, the value of \$10,000 in the fund may have been provided by a series of deposits or partial payments (usually called premiums) extending over a long period of years. For example, suppose it were the accumulation of thirty payments

of a thirty-year endowment policy. The annual payment to produce such a fund is figured thus:

$$\text{Table XXIV is: } \frac{s - 1}{s^n - 1} \text{ or } \frac{1.06 - 1}{1.06^{30} - 1} = \$0.0126$$

Thus 1.26 cts. paid into a fund every year for thirty years, accumulating at 6 per cent compound interest, will provide \$1 at the end of that period. Or \$10,000 may be provided by depositing

$$\$10,000 \times \$0.0126 = \$126 \text{ per annum}$$

In comparison with the premiums that any individual would be required to pay for endowment life insurance, these figures must necessarily appear very small for these represent net interest rates only. In the actual insurance premium, not only is the insured paying for protection during the period of accumulation of the fund but he must also pay the overhead expenses and profit to the insurance company which is willing and which has been established for the purpose of taking the insurance risk. However, before the business manager can determine whether his company should assume certain risks and provide its own fund to meet such emergencies as they appear, or whether the premium required by the insurance company for a policy to guarantee the same protection is to be adopted, similar calculations of both sinking-fund accumulations and resulting annuities must be made. The basic mathematical methods for such calculations should be familiar to the safety engineer and the executives of the corporation.

Little has been stated herein regarding the calculation of the premiums or annuities, which are necessarily involved in the various forms of insurance. Although their number is legion, the underlying principle of such calculations is simple, as outlined in the Chaps. XIII and XIV, which apply similar methods to interest, Discount, Present Worth, and Equivalence and to Annuities and Sinking Funds, respectively.

Bond Amortization.—Capital provided by borrowing must, of course, be paid back to the *individual bond or note holders* either before or at the maturity of the bond or note issue. Since the borrowed capital *as a whole* is not usually reduced to an equal extent, the problem of bond amortization involves the "paying off" of one set of bonds by means of money usually borrowed as the result of a second subsequent bond sale.

The word "amortization," although frequently used to describe several somewhat different accounting practices, usually refers to the "liquidation" or "paying off" of some large debt, such as a bond issue. Since such amortization must necessarily take place at some future and more or less predetermined time, a fund for this purpose is usually accumulated gradually by means of annual deposits or appropriations from earnings. The sinking-fund calculations are therefore most appropriate for such a purpose.*

To determine the amount of each of thirty equal annual payments, necessary to amortize, at maturity, a thirty-year issue of \$500,000 par value $5\frac{1}{2}$ per cent bonds with sinking-fund interest compounded annually at 5 per cent, the basic formula of Table XXIV is used, thus:

$$\frac{s - 1}{s^n - 1} = \frac{1.05 - 1}{1.05^{30} - 1} = \$0.0151$$

or $\$500,000 \times 0.0151 = \$7,550$ per annum.

In addition to this deposit to the sinking fund, however, the borrower must pay the annual simple interest, which may or may not be carried at the same rate as that of the sinking fund. Thus simple interest of $5\frac{1}{2}$ per cent upon this issue would involve an additional payment of $\$500,000 \times 0.055 = \$27,500$ per annum.

Suppose that, instead of raising the \$500,000 by means of a sinking fund, which will amount to that figure at the end of thirty years, we begin to pay it off at once by means of thirty equal annual payments which will just cancel the debt and its accumulated interest at 5 per cent at the end of thirty years.

Table XXVI indicates

$$\frac{s^n(s - 1)}{s^n - 1} \text{ or } \frac{s^{30} \times 0.05}{s^{30} - 1} = 0.0651$$

That means that \$1 will pay \$0.0651 per annum for thirty years, with interest accumulating and compounding annually upon the balance in the fund. The debt of \$500,000 may, therefore, be paid off with annual amounts of $\$500,000 \times 0.0651 = \$32,550$.

Or this may be considered the compound amount s^{30} (Table XXI) upon a principal of

* See Chap. XIV.

$$\frac{s - 1}{s^n - 1} \text{ (Table XXIV) or } s^{10} \text{ at 5 per cent} = \$4.322 \times 0.0151 \\ (\text{Table XXIV}) = 0.0651 \text{ (Table XXVI)}$$

or for this fund of \$500,000

$$\$500,000 \times 0.0151 = \$7,550; \quad \$7,550 \times 4.322 = \$32,550^*$$

Although these two annual obligations, or their equivalent, are always present, a third and rather more involved calculation results from the necessity of making up, during the life of the bond, the discounted values, i.e., the difference between the cash secured from the bonds and their par value, which must be paid back at their maturity.

Thus, for example, if bonds are sold at a 20 per cent discount (or at 80 per cent), the difference of \$20 in every \$100 of face value must be raised and paid to the creditor in addition to the actual cash borrowed from him in the first place. This would not affect the previous calculation since that was based upon the face value of the bond issue. However, the cash available and the yield from such a capital investment might prove inadequate to refund the discounted amount.

Bond Yields and Market Values.—The investor or creditor, who has purchased such bonds at a discount or at a premium, is also much interested in their yields upon his actual investment and the market values that are dependent upon such yields.

For example, what price should be paid for a ten-year \$1,000 bond bearing 5 per cent simple interest, payable annually, if it is to yield 6 per cent upon the investment, assuming that the interest payments are reinvested with the same yields.

The present worth of \$1,000 for ten years at 6 per cent is, from Table XXII,

$$\frac{1,000}{s^n} = \frac{1,000}{(1.06)^{10}} = 1,000 \times 0.5584 = \$558.40$$

The present value of an annuity of ten interest payments of $0.05 \times \$1,000 = \50 for ten years at 6 per cent from

$$\text{Table XXV is } \$50 \frac{s^n - 1}{s^n(s - 1)} = \$50 \frac{1.06^{10} - 1}{1.06^{10} \times 0.06} = \\ \$50 \times \$7.36 = \$368.00 \\ \text{Price to be paid} = \$926.40$$

* See also the problems of Chap. XIV.

Similarly, to find the theoretically correct price to pay for a \$1,000 ten-year bond bearing 5 per cent interest to yield 4 per cent upon the money invested:

$$\text{Table XXII} \quad \$1,000 \times \frac{1}{1.04^{10}} = \$1,000 \times 0.6756 = \\ \$675.60$$

$$\text{Table XXV} \quad \$50 \times \frac{1.04^{10} - 1}{1.04^{10} \times 0.04} = \$50 \times 8.111 = \\ \$405.55$$

Price to be paid = $\$1,081.15$

Obviously a bond, to yield more than its face value, will have been purchased at a discount, while the latter lower yield implies that the bond was purchased above \$1,000, i.e., at a premium.

Callable Bond Redemption.—In many bond issues provisions are made whereby the bonded company may call in or retire portions of the issue at prescribed periods, thereby changing the interest obligations for the remainder of the issue and also requiring the provision of adequate funds at certain intervals with which to redeem the bonds subject to call. In such a case it is frequently desirable to provide equal annual apportionments to reserves for such a purpose. A typical case will prove self-explanatory:

A five-year bond issue dated Jan. 1, 1937, of \$200,000 of \$1,000 par bonds bearing 8 per cent interest, payable semiannually, is callable by lot at par and accrued interest. A sinking fund is set up to retire the bonds, but the nearest whole number of bonds must be selected for retirement at each semiannual period. This semiannual amount required to pay interest and to retire bonds should be kept as nearly constant as possible during each period. A table is illustrated, including the following data: Date, Bonds outstanding, Semiannual deposit, Par value of Bonds retired, Number of Bonds retired:

\$200,000 (200 bonds) to be retired in ten periods with interest at 4 per cent per period:

$$\text{Table XXVI} = \frac{s^n(s - 1)}{s^n - 1} = \frac{1.04^{10} \times 0.04}{1.04^{10} - 1} = \$0.1233$$

	$\$200,000 \times 0.1233 = \$24,660$
Interest to July 1, 1937, $\$200,000 \times 0.04$	= \$ 8,000
	<hr/>
Balance will retire 17 bonds	\$16,660
	<hr/>
Extra deposit	\$17,000
	<hr/>
Extra deposit	\$ 340
	<hr/>
Semiannual payment	\$24,660
Second period July 1, 1937, to Jan. 1, 1938	
$\$200,000 \times 0.1233 = \$24,660$	
Less $\$183,000 \times 0.04$	= \$ 7,320
	<hr/>
Balance will retire 17 bonds	\$17,340
	<hr/>
Credit balance	\$17,000
	<hr/>
Credit balance	\$ 340
	<hr/>
Semiannual payment	\$24,660
Third period Jan. 1, 1938, to July 1, 1938	
$\$200,000 \times 0.1233 = \$24,660$	
Less $166,000 \times 0.04$	= \$ 6,640
	<hr/>
Retire 18 bonds	\$18,020
	<hr/>
Excess	\$18,000
	<hr/>
Excess	\$ 20

This results in Table XXVII.

Another practical comparison which may be made to good advantage, where one is planning the original or an amortized issue of bonds, involves the premium that is usually necessary in order to recall a portion of the bonds before maturity. Consider the two following possible 6 per cent sinking-fund plans of retiring an issue of \$500,000, consisting of twenty-year 5 per cent bonds with the provision (1) that one-half of the issue is to be retired in ten years at the premium of \$105, i.e., \$105 will be

paid for every \$100 bond in order to retire it at that early date, and (2) that the entire issue is to be retired at par at maturity (twenty years from its issue) by means of a sinking-fund reserve

TABLE XXVII.—BOND AMORTIZATION

Date	Bonds out-standing	Semiannual amount for interest and bonds returned	Interest at 4 per cent semi-annually	Par-value bonds retired	Number of bonds retired
Jan. 1, 1937	\$200,000				
July 1, 1937	\$183,000	\$25,000	\$8,000	\$17,000	17
Jan. 1, 1938	\$166,000	\$24,320	\$7,320	\$17,000	17
July 1, 1938	\$148,000	\$24,640	\$6,640	\$18,000	18
Jan. 1, 1939	\$129,000	\$24,920	\$5,920	\$19,000	19
July 1, 1939	\$110,000	\$24,160	\$5,160	\$19,000	19
Jan. 1, 1940	\$ 90,000	\$24,400	\$4,400	\$20,000	20
July 1, 1940	\$ 69,000	\$24,600	\$3,600	\$21,000	21
Jan. 1, 1941	\$ 47,000	\$24,760	\$2,760	\$22,000	22
July 1, 1941	\$ 24,000	\$24,870	\$1,880	\$23,000	23
Jan. 1, 1942	.....	\$24,960	\$ 960	\$24,000	24
	.....	.....	.....	\$200,000	200

accumulated by means of twenty equal payments during the intervening years:

PLAN 1

During the first ten years:

$$\text{Simple interest} = \$500,000 \times 0.05 = \$ 25,000$$

Amount to be retired

$$\$250,000 \times 1.05 = \$262,500$$

Ten-year sinking fund:

$$\text{Table XXIV at 6 per cent } \$262,500 \times 0.0759 = \$ 19,900$$

Twenty-year sinking fund:

$$\text{Table XXIV at 6 per cent } \$250,000 \times 0.0272 = \underline{\hspace{2cm}} 6,800$$

$$\text{Total annual obligation} = \$ 51,700$$

During the second ten-year period:

$$\text{Simple interest} = \$250,000 \times 0.05 = \$12,500$$

$$\text{Continuation of twenty-year fund} = \underline{\hspace{2cm}} \$ 6,800$$

$$\text{Total annual obligation} = \$19,300$$

It might be noted that the average of the annual obligations during the twenty years is

$$\frac{51,700 + 19,300}{2} = \$35,500$$

PLAN 2

During the entire twenty-year period:

$$\text{Simple interest} = \$500,000 \times 0.05 = \$25,000$$

Twenty-year sinking fund:

$$\begin{aligned} \$500,000 \times 0.0272 &= \$13,600 \\ &\hline \\ && \$38,600 \end{aligned}$$

The rather surprising conclusion is that the *average annual reserve obligation* under the ten-year plan is \$3,100 less than the twenty-year plan, in spite of the premium of 105 offered for the retirement of one-half of the bonds at the end of ten years. Of course, the high annual obligation of \$51,700 during the first ten years must be given serious consideration, since for the small or newly organized corporation this may prove to be an excessive burden during the early years of its existence. However, this lower average obligation should indicate the importance of a thorough consideration of several possible plans of amortization before the bonds are issued.

A recent statement of one of the large electric light and power corporations of the Middle West emphasizes the seriousness of bond amortization under the difficult credit and loan conditions of the depression years.

A study of the company's operating statement shows that during the past twelve months the *gross income has declined* 8.06 per cent. This loss has been brought about through a decrease of 8,392,006 in kilowatt-hours sold, or a loss of 9.74 per cent. The loss occurred largely in the sale of industrial power, since the sales for residence and commercial purposes remained practically unchanged during the period. To offset the loss in gross revenue, operating economies were effected which reduced the operating expenses for the period 12.18%. This left the *net earnings* showing a decline of *only* 2.34 per cent.

In view of this small decline in net earnings, there is naturally a question as to the necessity for deferring the payment of preferred dividends. This is accounted for by the refinancing with which the company was faced on Sept. 1, 1932. At that time the company was compelled to

provide approximately \$9,000,000 to meet bonds maturing, outstanding gold notes, and expenses incident to the refinancing. It is, of course, very difficult to obtain money under such conditions. Anyone familiar with farm lands or real estate knows that it is impossible to borrow as much money on the same security under such conditions as formerly. In order to obtain the loan on Sept. 1, it was necessary to scale down the mortgage by \$2,072,000 and to retire the outstanding gold notes. To do this, first-mortgage bonds amounting to \$6,000,000 were sold, the common stockholders provided \$750,000 of new capital, and a new series of gold notes due serially during the next three years were sold to the amount of \$2,250,000. The retirement of this large sum in a comparatively short period has placed a tremendous burden on the earnings of the company, and to meet this obligation it has been necessary to defer payment of the preferred dividends. Another factor to be considered in this connection is that, due to this necessary refinancing under adverse conditions, the annual interest requirements on the senior securities have been increased by approximately \$100,000. Also, the State Board of Assessment and Review has increased the company's property taxes by about \$40,000 per year.

Review Questions

1. A company with 5 per cent interest available agrees to pay group annual insurance to each of its employees in the form of ten equal annual payments of \$500 each at the end of 20 years of service. One-half of the necessary annual premiums to produce this annuity is to be taken from the employee's salary every year of such service, the company providing the other half. How much is the individual employee's annual salary decreased by such an obligation?
2. a. A man agrees to pay \$150 per year for a 20-year life insurance policy from which he will receive \$5,000 in 20 years. If he dies before 20 years, his heirs will receive \$5,000. What is the average yearly cost of the protection, exclusive of the endowment?
b. Assume this man exercises an option of his policy to have the \$5,000 paid to him in five equal instalments. What will be his annual income for the five years following its maturity? Assume all money draws 7 per cent compound interest annually.
3. For \$800 a year, a certain insurance company offers Mr. I. B. Thrifty at age forty an endowment policy maturing at age sixty-five (when premiums cease), which will give him \$1,200 a year for as long as he shall live. In case of death before the age of sixty-five, his beneficiary is to receive the face value (present worth of annuity) of the policy. Mr. Thrifty is told by the insurance agent that, if he reaches age sixty-five, he may expect to live to age eighty-three and that all money invested by the insurance company will earn 6 per cent, compounded annually on the average.
a. In case of death before age sixty-five how much does the beneficiary receive?

- b. What does this *insurance feature* cost Mr. Thrifty per annum? (*Hint:* premium less cost of endowment.)
4. a. On Dec. 31, Company A made the first payment in a 10-year 6 per cent sinking fund with which to pay employees' pensions. They estimate that one hundred \$1,000 annual pensions must be paid at the end of each year for 10 years beginning Dec. 31, 10 years later. How large an annual deposit will have to be made in such a fund to create a 5 per cent annuity with which to pay the estimated pensions?
- b. On Jan. 1, Company B made the first annual payment of \$10,000 into a 4 per cent sinking fund to retire a 20-year bond issue. What is the par value of the bond issue?
5. A certain employee will average a salary of \$2,000 a year for the next 20 years, at which time he will be automatically retired on a pension. If he contributes 1 per cent of his wages a year to a pension fund earning 5 per cent annual compound interest, and his employer a like amount, what *annual sum* would this man be able to receive from his share of the pension fund for the following 15 years after he retires?
6. a. What price must be paid for a \$1,000, ten-year, par-value bond bearing 5 per cent simple interest if all earnings are reinvested at 7 per cent and you wish to earn 6 per cent on your investment?
- b. What annual sum can be paid each year end for 10 years from the accumulated amount of a deposit of \$10,000 that was made in a savings bank 10 years ago at 4 per cent if all balances remain in the bank at the same interest rate?
7. Determine the purchase price of a \$100 six per cent bond, with annual dividends to yield 5 per cent on the purchaser's investment, if the bond will be redeemed in 10 years at \$110.
8. How much will you have to invest in a \$1,000 bond bearing 5 per cent simple interest, reinvested at 7 per cent to secure a total yield of 7 per cent upon your investment during the life of the bond of 20 years?
9. A broker is ordered to invest \$5,000 of A's money and \$4,000 of B's money in 5 per cent \$1,000 bonds maturing 8 years hence. A wishes a yield of 6 per cent on his investment, while B is satisfied with 4 per cent. Assuming the simple interest to be reinvested at the yield rates desired in each case, what market price will the broker have to obtain?
10. The present worth of a 10-year 5 per cent \$500 bond is \$540.58. Of this present worth, 37.4 per cent results from the reinvestment of the simple interest at the same compound-interest yield as that enjoyed upon the original investment in the bond itself. What is this percentage yield?
11. A 20-year \$1,000 bond is purchased for \$885. Its simple-interest payment is 5 per cent on the face value. What is the average annual percentage yield during the 20-year period on the amount actually invested if the simple interest received each year and the lump-sum discount are invested at compound interest at 6 per cent?
12. A company borrows \$100,000 by means of the sale of one thousand 25-year 5 per cent bonds. It finds, however, that these bonds can be marketed only at a discount and they are therefore sold for cash at \$95 each. If it is possible for the company to make an annual profit of 10 per cent upon

this borrowed-cash capital before bond interest is paid and before 6 per cent amortization funds are reserved, what is the net annual profit in per cent upon the face value of the bond issue?

13. The ABC Electric Company has outstanding a 5 per cent \$100,000 bond issue maturing in 20 years. Half of this bond issue may be called at 105 in 10 years. If the company has 6 per cent money compounded annually available and wishes to retire the bond issue with one of two possible methods involving the lesser total outlay, what will be their annual obligation, (a) the first 10 years; (b) the second 10 years.

14. An issue of \$100,000 of 5 per cent bonds matures in 20 years. At what price or premium must the bonded company retire one-half of the bonds at the end of 10 years, and the remainder in 20 years at face value, in order to have the average annual obligation over the 20 years equal to that required by a 20-year sinking-fund method applied to the entire issue? Both methods make use of 6 per cent sinking funds.

15. If the profits of a business having a \$100,000 bond issue permit the use of \$8,720 per annum for the payment of the 6 per cent simple interest on the loan outstanding and the retirement of some bonds each year, how many years (approximately) will be required for the complete amortization of the issue?

16. A 20-year bond issue of one thousand \$1,000 bonds bearing 5 per cent simple interest must be amortized by one of the following methods: method *A*—retire one-half the issue at 104 per cent in 10 years by means of a 10-year 6 per cent sinking fund and the remainder in 20 years by a 20-year 6 per cent sinking fund; pay simple interest when due; method *B*—retire as many bonds as possible each year after deducting simple interest by the 20-year 6 per cent annuity method. Compare the annual obligation of methods *A* and *B*.

17. A 5-year bond issue of \$200,000 of \$1,000 par bonds bearing 5 per cent interest payable annually is callable by lot at par and accrued interest on any interest period. It is decided to select for retirement at each interest period the nearest whole number of bonds and pay all interest. The total annual amount thus expended is not to exceed the annuity paid by a 5 per cent sinking fund necessary to retire the issue at the end of 5 years. What is the annual obligation and the number of bonds that can be retired each year?

18. A 20-year bond issue of \$500,000 bearing 5 per cent interest must be amortized by calling one-half the par value in 10 years at 105 and the remainder at par at maturity. The annual sinking funds for both refunds bear 6 per cent interest.

- a. What is the annual obligation during the first 10 years?
- b. For last 10 years?
- c. If the callable feature were not involved and all the bonds retired at maturity at par, what would be the annual obligations?

19. How many whole bonds of \$1,000 par value each in a bond issue of \$50,000 should be retired during each of the 5 years of the life of such bonds if the simple interest of 6 per cent upon the outstanding balance is paid each year and if the money available for this purpose remains approximately equal each year?

CHAPTER XVI

PRINCIPLES OF ACCOUNTING

Although it is not the purpose of this chapter to train the engineering student as an expert accountant, it is believed that every engineer and executive should be familiar with the elementary principles of accounting in order that he may analyze the results of his economic estimates and know the limits of his analytical abilities so that he may seek the services of and be able to direct an accountant, if necessary, at the most appropriate time.

This chapter, therefore, has the point of view of the engineering executive, introducing only those subjects in which such an executive may profitably interest himself. It emphasizes the interpretation and use of accounting material rather than the details of bookkeeping or the ways and means of determining such data.

It may be argued also, in opposition to such a procedure, that these elementary forms are taught in most of the grade or high schools, not to mention the courses in business colleges which have been undertaken by many engineering students. The only justifiable answer is: the average engineering student does not understand accounting and is unable to analyze either an income statement or a balance sheet. Both are very likely to be met and considerable knowledge thereof required at the most inopportune time in the career of the young engineer who has not adequately prepared himself.

Accounting is one of the important tools of management. Since most businesses have become more complex and competitive and since the public utility monopolies have been subjected to more rigorous regulation, the modern executive in every line must depend upon an adequate accounting system and must understand its operation and its limitations.

The functions and scope of an adequate accounting system have been well set forth by Greer as follows:¹

First, the accountant is expected to record all commercial transactions whose results may be expressed in money terms. This involves the establishment of contact with all phases of the operation of a business, and the provision of a standardized system of record keeping. Some means must be found for determining the money equivalents of all properties, services, etc., that enter into the history of the enterprise, and a technique must be devised for setting up these items on the books of account according to a uniform and well coordinated plan.

Second, when the accountant has evaluated all transactions and adequately expressed their effect, he must classify and summarize the results. Thousands of transactions occur in business, and a mere recital of their particulars would be meaningless. The total of increases and decreases in every significant item of property, in the property interests of every individual who has dealings with the enterprise, must be found and recorded; the final effect of the buying, manufacturing, selling, receiving, and paying transactions must be determined and expressed.

Third, the accountant must present these results in logical, understandable form. Managers, owners, investors, leaders, trade creditors—all may require information as to the concern's standing and the financial results of its operations. This information it is the function of the accountant to supply.

Fourth, the accountant should furnish analyses of the results shown in his books. Bald statements of items and amounts, barren in themselves, become illuminating and vital when amplified with comparisons, relationships, results in units of physical volume, rates of yield, and the like. This interpretation of financial facts in managerial terms is one of the accountant's greatest responsibilities.

Fifth, from his analysis of past and present, the accountant should provide invaluable aid in planning for the future. Schooled in expressing the facts of past operations, he should be equally apt in calculating the effect of proposed undertakings. He must project into the future the financial consequences of anticipated programs, and a "budget" must be built in terms of the information he has to supply.

Sixth, he must check, verify, prove, and control every feature of business operations through a complete record of all that occurs and a comparison of the situation that actually exists with that which should exist as a result of what has transpired. No fraud or error can go undetected, no agreed program can be disregarded, if the accounting methods of a concern are adequate and efficient.

The accountant may do other things; some of the things just mentioned may be done by others, or not at all. It is safe to say, however, that accounting procedure, properly developed, furnishes the most

effective means of accomplishing the aims just described, . . . an accomplishment vital to successful business enterprises. . . .

In the business enterprise itself accounting work will be found to subdivide itself along the lines of the functions easily recognized in the operation of the business. . . .

One section of accounting, for example, will have to do with the recording of purchases and the handling of accounts with trade creditors. A second section will comprise the work of calculating the compensation of employees, preparing pay checks or envelopes, and making up the summary lists or pay rolls. A third will be concerned with the problems of manufacturing costs, expense distributions, and burden application. A fourth will deal with the recording of sales, the maintenance of accounts against customers and the adjustments for returns, allowances, price corrections, and the like. A fifth will operate in close conjunction with the financial department, recording cash receipts and payments, bank loans, security issues and retirements, and similar matters.

When a manufacturing or a merchandising sales enterprise is first undertaken, the proprietorship, partnership, or corporation usually has only cash on hand or a bank balance with which to begin operations. The basic equation for all accounting is: that the value of property is equal to the value of interests in the property or

$$\text{Assets (property)} = \text{equities (interests in property)}$$

If the cash available is \$100,000, the first equation is:

Cash \$100,000 = interest (equity of Edward Jones or of all the stockholders in the company) \$100,000.

The first process to be accounted for after the business has been established is usually the purchase of some of the following equipment:

1. Land and buildings.
2. Machinery.
3. Insurance, rent, taxes, professional services, etc.
4. Services of officials, managers, foremen, and laborers.
5. Raw materials.

The purchasing having been well started, the transformation process from raw material to finished product begins and we are soon ready to consider the sale of our output, whether it be auto-

mobiles or electrical energy, in a form to be of immediate use to a consumer.

In order to keep adequate account of our costs, to determine a proper selling price for our product, and to record properly and distribute effectively our profits, if we are fortunate enough to have them, a suitable system of accounting must be selected and established. The object of a complete system of accounts is to be able to determine at any time the exact financial status of the manufacturing processes and business transactions, and particularly to indicate the condition of the capital.

Bookkeeping is the mechanism or tool that enables the executive to determine the status of the accounts of the business. Accounting should be differentiated from bookkeeping, as the former is the interpretation of the results presented by the bookkeeping process. Since bookkeeping is a tool and a measuring instrument by means of which one follows the relative values of materials and energy through the various processes of manufacturing and transformation, it is at once apparent that everyone associated with, or interested in, any of these processes, from original purchase to final sale, must necessarily know something of its principles.

Bookkeeping is not fundamentally complex, although its various ramifications in a large corporation carrying many accounts may be difficult for the inexperienced person to trace. In the case of a simple purchase, and with the early form of single-entry bookkeeping, a record is made ordinarily in two books, the *journal* (or *day book*) and the *cash book*. These books are called *books of original entry*. If 100 tons of coal were purchased of the Diamond Coal Company by the Jonesville Light and Power Company on Mar. 1, 1937, and 200 tons by the Morgantown Railway and Light Company on Mar. 5, the entries in the Sales and Cash Books of the Diamond Coal Company would be as follows:

Journal
Diamond Coal Company

1937

Mar. 1	Jonesville Light and Power Company	
	100 tons Indiana run of mine at \$3.10	\$310.00
Mar. 5	Morgantown Railway and Light Company	
	200 tons screenings at \$2.05	\$410.00

Suppose in addition to the above transactions, assuming the balance of \$1,524.73 has been carried forward from February, the Jonesville Light and Power Company pays its bill in full on Mar. 31 and the Diamond Coal Company purchases mining machinery costing \$1,242.50 for cash. The items appear on the cash book of the Diamond Coal Company thus:

Cash Book			
1937	Cash Dr.		Cash Cr.
Mar. 1 To Balance Forward	\$1,524.73	Mar. 3 By Expense Laborers	\$ 31.50
Mar. 31 To Jonesville Light and Power Company Ac- count in full	310.00	Mar. 10 By Merchandise	\$1,242.50
	<hr/>	Mar. 31 By Balance	560.73
	<hr/>		<hr/>
	\$1,834.73		\$1,834.73
Apr. 1 To Balance	\$ 560.73		

The credit entry "By Balance \$560.73" is usually made in red ink.

From the journal, in which each transaction is recorded chronologically, the entries are transferred to the ledger. In the latter book the accounts are kept in the name of the contracting party, or in such impersonal groups as pay roll, rent, etc., and a page or several consecutive pages are assigned to the accounts of one particular group or customer assignment. The ledger account for the above transactions would appear as follows:

Ledger		
Jonesville Light and Power Company		
Dr.		Cr.
1937		
Mar. 1 To Merchandise	4 \$310.00	Mar. 31 By Cash
		13 \$310.00

Morgantown Railway and Light Company		
Dr.		Cr.
1937		
Mar. 5 To Merchandise	4 \$410.00	

These three books, the journal, cash book, and ledger, are the fundamental books of all business transactions. In some instances where the business is small, such as a country retail store, the journal and ledger may be combined. The ledger then becomes the book of original entry. In large corporations, with many departments, many sub ledgers may be necessary. These accounts in the various ledgers are summarized in the *control ledger*, in which totals from departments only are recorded and balanced. A glance at the control ledger will reveal the status of such, as Accounts Receivable and Accounts Payable.

Although the principle involved is the same in the bookkeeping systems of various kinds of business, the form and ruling of the books used may vary considerably. In some cases the ledger accounts may be kept upon cards properly classified, filed, and indexed in a card catalogue. Loose-leaf ledgers are also popular in some offices because of the fact that, when an account is closed, the pages of no further use may be removed and the size of the book greatly reduced. Both the card and loose-leaf ledgers are subject to the objection, however, that leaves or cards may easily be lost or misplaced and embarrassing confusion or financial losses may result. Many other short cuts to bookkeeping will be found in various lines of business, such as the use of sales tickets with carbon copies properly classified and filed in place of ledger accounts. The elaborate cash registers and business-machine card classification now available represent in themselves almost a complete bookkeeping system for a wide variety of sales records.

VOUCHER SYSTEM

A rather recent simplification of such books maintained for accounts payable is now frequently found in the *voucher register*. Vouchers are formal individual records of the invoices to be paid. These are usually numbered serially and often are either a part of or perforated and detachable from the check bearing the same serial number. Since no complete account with the creditor may appear on the books, and since each transaction must stand on its own feet, such vouchers must have very careful inspection and approval by those in authority and must be recorded and filed in accordance with a precise system. Through this device, used to great advantage in corporations where there are many similar small accounts, the subsidiary accounts payable ledger

is eliminated while the voucher register includes the only record of the corporation's obligations.

The above examples refer to comparatively simple transactions in trade which are recorded by what is known as single-entry bookkeeping. As its name implies, there is but one entry per transaction in any one book. Although single-entry bookkeeping is not productive of the accuracy and the final analytical reports and balances that the double-entry system provides, it is still used to a considerable extent in small corporations. It is also of sufficient value as a basis for understanding the double-entry system to warrant considerable discussion.

All books in this country carry debit items at the left and credit items at the right. They may be in separate columns on the same page or different pages may be assigned. In England the opposite method of paging has become customary.

By debit upon the proprietor's books is meant:

1. The recording by the proprietor, in the name of the customer, of the claims against such a customer arising from the sale to the latter of merchandise by the former.
2. The recording by the proprietor of the reduction or settlement in full of a claim payable to a person who has extended credit to the proprietor for merchandise purchased by the latter.
3. The recording by the proprietor, in his own account, of the net decrease of the values invested by him.

By credit, upon the proprietor's books, is meant:

1. The recording by the proprietor of the reduction or settlement in full of his claim against a customer, arising from the receipt of money, or its equivalent, from that customer.
2. The recording by the proprietor of a debt that he has incurred through purchases on credit.
3. The recording by the proprietor in his own account, of the net increase of the value invested by him.

Equations of the single-entry system:

1. Initial assets* less initial liabilities† = initial net worth.

* "Assets," in general, may be defined as property (used in its broadest economic sense) owned by the proprietor or business enterprise; or any prospective and probable moneys and/or other values which are reasonably likely to be realized in the near future by the enterprise, such as accounts and bills receivable, etc.

† "Liabilities," by way of contrast, are the obligations of the proprietor or business enterprise to pay moneys or to release values to creditors; or moneys and/or other values which may become such obligations in the future.

2. Increases of assets and decreases of liabilities = factors in favor of proprietor.

3. Decreases of assets and increases of liabilities = factors against proprietor.

4. Factors for the period in favor of the proprietor less factors for the period against the proprietor = net increase of net worth.

5. Assets at end of period less liabilities at end of period = net worth at end of period.

6. Net worth at end of period less net worth at beginning of period = net increase of net worth during the period.

Equation 6 does not refer to profits if capital contributions or withdrawals have been made. In such cases 7 and 8 apply.

7. Profit = net increase of net worth less contributions of capital.

8. Profit = net increase of net worth plus withdrawals of capital.

The details of the profit and loss are not so readily determined in single-entry bookkeeping as in double-entry bookkeeping.

Although it is often stated that single-entry bookkeeping is not accurate and does not offer the opportunity of suitable summary in a balance sheet and profit and loss account, the following sample books will indicate the methods used in such accounts and a fairly satisfactory means of drawing conclusions therefrom which in many of the more simple instances take the place of double-entry balance sheets.

**Proprietor's Account
SINGLE-ENTRY LEDGER
Classified Transactions**

1937	1937		
Jan. 1 Assets Invested:		Jan. 1 Liabilities:	
Cash	\$ 75,000.00	Mortgage Payable	\$ 50,000.00
Merchandise	10,000.00	Notes Payable	30,000.00
Land and Buildings	130,000.00	Due Creditors	20,000.00
Autos and Trucks	20,000.00	Net Investment to Bal-	
Furniture and Fixtures	15,000.00	ance	150,000.00
	\$250,000.00		\$250,000.00

such as outstanding bonds, notes, and shares of stock and/or accounts and bills payable, etc.

"Current assets" and "current liabilities," as the words imply, are assets and liabilities which are *real* and *immediate* in form, usually interpreted as such as may represent cash to be owned or obligated respectively during the forthcoming thirty days.

Proprietor's Account—(Continued)

Jan. 1-June 30	Jan. 1-June 30
Net Investment \$150,000.00	
Assets Acquired:	Assets Parted with:
Merchandise Purchased \$120,000.00	Merchandise (at cost) \$ 90,000.00
Cash from Customers 70,000.00	Cash Paid Creditors 95,000.00
Cash from Interest 500.00	Cash Paid Notes Payable 30,000.00
Notes from Customers 500.00	
Customer's Accounts 29,500.00	Cash Paid Current Expense 3,000.00

	\$220,500.00 Total \$218,000.00
Liabilities Reduced:	Liabilities Incurred:
Paid Notes Payable \$ 30,000.00	Notes Payable to Creditors \$ 11,000.00
	Increase Creditor's Accounts 14,000.00

	\$ 25,000.00
	Net Investment to Balance 157,000.00

Total \$400,500.00	Total \$400,500.00

Merchandise Transactions

Debits:	
Initial Inventory	\$ 10,000.00
Purchases	120,000.00
Total Debits	\$130,000.00
Credits:	
Cost of Goods Sold (i.e., Purchase Cost)	90,000.00
Closing Inventory (Cost of Goods Purchased Less Cost of the Part of Goods Sold)	\$ 40,000.00

Customer's Transactions

Debits:	
Initial Balance (none)	\$.....
Sales:	
Settled for in Cash	\$ 70,000.00
Settled for by Notes	500.00
Balance on Open Accounts	29,500.00
Total Debits	\$100,000.00
Credits:	
Cash Received	\$70,000.00
Promissory Notes	500.00
Total Credits	\$70,500.00
Balance Due from Customers	\$29,500.00

Creditor's Transactions

Credits:	
Initial Balance	\$ 20,000.00
Purchases	<u>120,000.00</u>
Total Credits	\$140,000.00
Debits:	
Cash Paid to Creditors	\$95,000.00
Notes	<u>11,000.00</u>
Total Debits	<u>106,000.00</u>
Balance Due to Creditors	\$ 34,000.00

TRANSACTIONS IN NOTES PAYABLE (OBVIOUS)
TRANSACTIONS IN NOTES RECEIVABLE (OBVIOUS)**Cash Transactions**

Debits:	
Initial Investment	\$75,000.00
Received from Customers	70,000.00
Credit by Bank for Interest	<u>500.00</u>
Total Debits	\$145,500.00
Credits:	
Paid to Creditors	\$95,000.00
Paid Notes Payable	30,000.00
Paid Current Expenses	<u>3,000.00</u>
Total Credits	<u>\$128,000.00</u>
Balance on Hand	\$ 17,500.00

Profit and Loss

Profits:	
Gross Profits on Merchandise Sales	\$100,000.00
Less Cost of Sales	<u>90,000.00</u>
Interest on Bank Balance	<u>500.00</u>
Expenses	\$10,500.00
New Profit	<u>3,000.00</u>
	\$ 7,500.00

Financial Statement
 (Equivalent of Balance Sheet)

	Assets			
	Jan. 1, 1937	June 30, 1937	Increases	Decreases
Cash.....	\$ 75,000.00	\$ 17,500.00		\$57,500.00
Merchandise.....	10,000.00	40,000.00	\$30,000.00	
Land and Buildings.....	130,000.00	130,000.00		
Autos and Trucks.....	20,000.00	20,000.00		
Furniture and Fixtures.....	15,000.00	15,000.00		
Sundry Customers.....		29,500.00	\$29,500.00	
Notes Receivable.....		500.00	500.00	
	\$250,000.00	\$252,500.00	\$60,000.00	\$57,500.00

	Liabilities			
			Decreases	Increases
Mortgages Payable.....	\$ 50,000.00	\$ 50,000.00		
Notes Payable.....	30,000.00	11,000.00	\$19,000.00	
Creditor's Accounts.....	20,000.00	34,000.00		\$14,000.00
	\$100,000.00	\$ 95,000.00	\$19,000.00	\$14,000.00
Proprietor's Capital.....	150,000.00	150,000.00		
	\$250,000.00	\$245,000.00		
Total Increases and Decreases.....			79,000.00	71,500.00
Net Increase of Investment.....			\$ 7,500.00	

DOUBLE-ENTRY ACCOUNTING

This form of accounting is simply a detailed expansion and application of the basic equation of all business, which may be repeated as

Assets = liabilities (debts) plus net worth (one credit and one debit)

Double entries, as the term implies, are made for every transaction and for every transfer of any item from one account to another. This system includes, therefore, every possible feature of business and finance.

In studying these typical entries and their analysis as the best means of understanding the double-entry system, two important premises must be borne in mind:

1. Accounting records transactions in terms of money values.
2. Accounting refers to a single enterprise, whether it be a proprietorship, partnership, or corporation, and expresses every

transaction from the point of view of that particular enterprise recognized as an independent entity. Such accounts show the relation of the enterprise, not only to its own property, its customers, and its creditors, but to its owners as well. The accounts, as independent representations of the business to its owners, are probably of greatest importance and value.

These relations, in their restriction to the one enterprise and its owners, distinguish accounting from statistical analysis, which usually involves comparative data and accounts of several enterprises.

In the following illustrative transactions and entries, if the reader will place himself in the position of the business itself as an independent entity apart from proprietors, customers, and creditors, and if he will ask himself whether or not a certain transaction or transfer of accounts (considered in terms of cash whenever possible) tends to increase or decrease the worth or assets of the business or of the account in question, he will be able to visualize better the proper entries to be made. For example, if cash, recognized as an asset, is decreased or paid out, one of two things must happen; some other asset must be acquired in its place (more merchandise purchased, for example) or someone's equity in the business must be reduced.

It follows, therefore, that, having set up the original equation, any change in the financial situation may be expressed by another equation containing both a debit and a credit element, the two always of equal amount. This will not disturb the validity of the original equation although its numerical values may have been changed. A debit may be considered as having increased the asset or decreased the equity. A credit may be considered as having decreased the asset or increased the equity.

Double-entry bookkeeping and accounting, therefore, consist in properly classifying the debit and credit elements of all transactions and transfers, thereby maintaining throughout an equation which at all times sets forth the financial status of the business.

Suppose, by way of illustration of the details of double-entry accounting from a few typical transactions of a manufacturing and sales organization to be known as *A Company*, that the charter has been granted to this corporation as described in Chap. VI; it is now about to start its transactions with the *cash capital* of \$150,000 which it has secured from the sale to its stockholders of 1,500 shares of *A Company* stock at \$100 each, for

which the \$150,000 has been paid in cash. Chronological journal entries might be listed thus:

Transactions	
DATE	AMOUNT
July 1, 1936 Sold 1,500 shares of A Co. stock at \$100 each for cash	\$150,000
July 15, 1936 Purchased factory from E Co. (property or physical plant)	60,000
July 16, 1936 Paid E Co. cash toward factory	40,000
July 17, 1936 Gave E Co. 6 per cent note for	20,000
July 18, 1936 Paid cash for insurance premium for year	200
July 19, 1936 Purchased, for cash, 100 tons coal at \$5 -	500
July 20, 1936 Purchased 50 machine tools, averaging \$500 each, on account from B Co.	25,000
July 21, 1936 Gave B Co. 6 per cent note on account	25,000
July 23, 1936 Purchased raw materials from C Co. on account for	10,000
Aug. 1, 1936 Employed varied salaried group of employees averaging 1,200 per month	Memo
Aug. 15, 1936 Paid out cash for miscellaneous wages	600
Aug. 17, 1936 Paid cash for interest to date on note to E Co.	100
Aug. 21, 1936 Paid cash for interest to date on note to B Co.	125
Aug. 31, 1936 Sold 50 units of manufactured product at \$100 each to D Co. on account	\$ 5,000
Aug. 31, 1936 Paid salaries for August in cash	1,200
Aug. 31, 1936 Paid cash for electric light and power	1,514
Sept. 2, 1936 Sold 100 units of manufactured product for cash at \$100 each	10,000
Sept. 3, 1936 Paid C Co. cash on account	6,000
Sept. 4, 1936 Received 6 per cent note from D Co. on account	5,000
Sept. 17, 1936 Paid E Co. cash on note	10,000
Sept. 17, 1936 Paid E Co. interest to date on note in cash	100
Sept. 21, 1936 Paid B Co. face of note with interest to date in cash	25,125
Sept. 30, 1936 Paid cash for electric light and power	1,635
Sept. 30, 1936 Paid salaries for September in cash	1,200
Oct. 17, 1936 Paid E Co. interest on balance of note to date in cash	50
Oct. 31, 1936 Paid cash for electric light and power	1,750
Oct. 31, 1936 Sold 300 units of product at \$100 each for cash	30,000
Oct. 31, 1936 Paid salaries for October in cash	1,200
Nov. 4, 1936 D Co. paid face value of note with interest to date	5,050
Nov. 15, 1936 Sold 150 units of manufactured product to D Co. on account at \$100 each	15,000
Nov. 16, 1936 Paid C Co. cash on account	2,000
Nov. 17, 1936 Paid E Co. interest on balance of note to date in cash	50
Nov. 18, 1936 Received cash on account from D Co.	10,000
Nov. 30, 1936 Paid cash for electric light and power	1,822

Transactions—(Continued)

DATE		AMOUNT
Nov. 30, 1936	Paid cash for November salaries	1,200
Nov. 30, 1936	Repairs to machines (paid in cash)	1,100
Dec. 5, 1936	Sold 60 units of manufactured product at \$100 each for cash	6,000
Dec. 31, 1936	Paid E Co. interest on balance of note to date in cash	75
Dec. 31, 1936	Paid cash for electric light and power	2,143
Dec. 31, 1936	Paid cash for December salaries	1,200
Dec. 31, 1936	Enter taxes accrued to date	1,100
Dec. 31, 1936	Inventory of raw materials on hand (coal all used)	2,200
Dec. 31, 1936	Inventory Goods in Process (at cost)	2,500
Dec. 31, 1936	Inventory Finished Goods (at cost)	4,200
Dec. 31, 1936	Depreciation Reserve on Building and Machines	3,700
Dec. 31, 1936	Directors declared dividend of	20,000

Note: a. Assume one-half of the pay roll is in the factory and one-half is devoted to sales and administrative expense.

b. Assume three-fourths of the general expense is chargeable to direct labor and one-fourth to overhead.

It becomes necessary to open the following ledger accounts, or their equivalents, approximately in the sequence indicated, and to make double entries in such accounts as the transactions proceed which will maintain the proper balance of the original equation:

1. Cash.
2. Proprietorship.
3. Physical Plant (see Chaps. IX and XI).
4. E Company (a creditor).
5. Notes Payable.
6. Insurance (prepaid).
7. Materials Stores (see Chap. IX).
8. Notes Receivable.
9. B Company (a creditor).
10. C Company (a creditor).
11. Pay Roll.
12. Interest (outgoing).
13. D Company (a debtor).
14. Interest (incoming).
15. Merchandise Sales.
16. Miscellaneous Expense.
17. Taxes (accrued).
18. Burden (see Chap. XVII).

19. Depreciation Reserve (see Chap. X).
20. Dividends Declared (see Chaps. V and XXI).
21. Profit and Loss.
22. Work in Process.
23. Finished Goods (at cost).

Probably the entries in the Cash Account are most easily visualized; for example, the increase of the cash on hand which resulted from the sale of stock involved a debit entry of \$150,000 in the cash account and a credit entry of the same amount (i.e., an obligation to the stockholders) in the proprietorship account. Conversely, the purchase of the factory reduced the cash balance and therefore credited the cash account by \$40,000, but simultaneously increased the assets of the "physical plant," involving thereby a debit to the latter account of \$60,000.

Some of the more intangible entries may be less easily recognized, such as debiting the account of E Company with the note of \$20,000, representing the balance of the factory purchase price, and crediting Notes Payable by the same amount at the time the note is forwarded. However, the subsequent payment in cash of half of the note (\$10,000) to E Company on Sept. 17 is readily seen to involve a credit to cash, i.e., a reduction of the cash balance and a debit (not to E Company which has previously been entered) but to Notes Payable, since this transaction "reduced the obligation" in this account.

Since this series of transactions involves the record of raw materials, work in process, burden, and finished goods as they proceed through the factory, and also the sales transactions as well, some of these accounts will be recognized as those involved in Cost Accounting (see Chap. XVII). In fact, it is frequently difficult to differentiate between cost accounting and general accounting, the basic equation being identical for both. Just as burden accumulates and gradually adds to the worth of the work in process or the finished goods, so interest, taxes, and other overhead expenses accrue in their respective debit accounts and are paid from time to time by cash payments involving credits to the cash account.

With these suggestions as to the principles involved, the following entries will be readily understood as one possible and practical solution of the desirable, although not absolutely necessary, intermediary accounts:

Cash Account

July 1	From Stock Sale	\$150,000	July 16	Factory E Co.	\$ 40,000
Sept. 2	100 Units sold	\$ 10,000	July 18	Insurance	200
Oct. 31	300 Units sold	30,000	July 19	Coal	500
Nov. 4	Note D Co.	5,000	Aug. 15	Wages	600
Nov. 4	Interest D Co. (2 months)	50	Aug. 17	Interest note E Co.	100
Nov. 18	D Co. on ac- count	10,000	Aug. 21	Interest note B Co.	125
Dec. 5	60 Units sold	6,000	Aug. 31	Salaries August	1,200
			Aug. 31	Electric light and power	1,514
			Sept. 3	C Co. account	6,000
			Sept. 17	E Co. note	10,000
			Sept. 17	Interest note E Co.	100
			Sept. 21	B Co. note	25,000
			Sept. 21	Interest note B Co.	125
			Sept. 30	Electric light and power	1,635
			Sept. 30	Salaries September	1,200
			Oct. 17	Interest E Co. note	50
			Oct. 31	Electric light and power	1,750
			Oct. 31	Salaries October	1,200
			Nov. 16	C Co. account	2,000
			Nov. 17	Interest E Co. note	50
			Nov. 30	Electric light and power	1,822
			Nov. 30	Salaries Novem- ber	1,200
			Nov. 30	Repairs	1,100
			Dec. 31	Interest E Co. note	75
			Dec. 31	Electric light and power	2,143
			Dec. 31	Salaries Decem- ber	1,200
<hr/>		<hr/>	Total	\$211,050	<hr/>
			Total	\$100,889	
				110,161	
<hr/>		<hr/>		\$211,050	

			Proprietorship	
			July 1 Stock	\$150,000
Physical Plant				
July 15	Factory	\$60,000		
July 20	Machine Tools	25,000		
			<hr/>	
	Total	\$85,000		
E Company				
July 16	Cash	\$40,000	July 15 Factory	60,000
July 17	Note	20,000		
			<hr/>	
	Total	\$60,000		
Notes Payable				
Sept. 17	E Co. note	\$10,000	Sept. 17 E Co.	20,000
Sept. 21	B Co. note	25,000	Sept. 21 B Co.	25,000
			<hr/>	
	Total	\$35,000	Total	\$ 45,000
				35,000
				<hr/> \$ 10,000
Insurance Prepaid				
July 18	Premium (1 year)	\$ 200	Dec. 31 Burden	\$ 100
		100		
		<hr/>		
		\$ 100		
Stores				
July 19	Coal	\$ 500	July 1-Dec. 31 To Work in Proc- ess	\$ 7,800
July 23	Materials C Co.	10,000	July 1-Dec. 31 To Work in Proc- ess	500
	Total	\$10,500	Total	\$ 8,300
		8,300		
		<hr/>		
Dec. 31	Inventory Mat.	\$ 2,200		
Notes Receivable				
Sept. 4	D Co.	\$ 5,000	Nov. 4 D Co. Note	\$ 5,000
B Company				
July 21	Note	\$25,000	July 20 Machine Tools	\$ 25,000

		C Company		
Sept. 3	On Account	\$ 6,000	Sept. 23	Materials \$ 10,000
Nov. 16	On Account	2,000		8,000
				<hr/>
	Total	\$ 8,000		Accounts Payable \$ 2,000

		Pay Roll		
Aug. 15	Wages	\$ 600	Dec. 31	To Work in Process \$ 3,300
Aug. 31	August Salaries	1,200	Dec. 31	To Sales 3,300
				<hr/>
Sept. 30	September Salaries			Total \$ 6,600
		1,200		
Oct. 31	October Salaries	1,200		
Nov. 30	November Salaries			1,200
Dec. 31	December Salaries			1,200
				<hr/>
	Total	\$ 6,600		

		Interest Outgoing		
Aug. 17	E Co.	\$ 100	Dec. 31	To Burden \$ 625
Aug. 21	B Co.	125		
Sept. 17	E Co.	100		
Sept. 21	B Co.	125		
Oct. 17	E Co.	50		
Nov. 17	E Co.	50		
Dec. 31	E Co.	75		
				<hr/>
	Total	\$ 625		

		D Company		
Aug. 31	50 units	\$ 5,000	Sept. 4	Note \$ 5,000
Nov. 15	150 units	15,000	Nov. 18	Cash 10,000
				<hr/>
	Total	\$20,000		Total \$ 15,000
		15,000		
				<hr/>
		\$ 5,000		

		Interest Incoming		
Dec. 31	To Profit and Loss		Nov. 4, 1932	D Co. \$ 50
		\$ 50		

Merchandise Sales				
Dec. 31	From Finished Goods Cost Sales Pay Roll	Aug. 31 \$20,389 3,300	D Co. account 50 units Sept. 2 100 units cash	\$ 5,000 10,000
	Total	\$23,689	Oct. 31 300 units cash	30,000
Dec. 31	To Profit and Loss	42,311	Nov. 15 150 units D Co.	15,000
			Dec. 5 60 units cash	6,000
	Total	66,000	Total	66,000
General Expense				
Aug. 31	Electric Power and Light, August	Dec. 31 \$ 1,514	To Work in Process	\$ 7,473
Sept. 30	Electric Power and Light, September	Jan. 4 1,635	To Burden	2,491
Oct. 31	Electric Power and Light, October	1,750	Total	\$ 9,964
Nov. 30	Electric Power and Light, November	1,822		
Nov. 30	Repairs	1,100		
Dec. 31	Electric Power and Light, December	2,143		
	Total	\$ 9,964		
Taxes Account				
		Dec. 31	Accrued	\$ 1,100
Burden				
Dec. 31	Insurance	\$ 100	Dec. 31 To Finished Goods	\$ 8,016
Dec. 31	Taxes	1,100		
Dec. 19	Depreciation	3,700		
Dec. 31	Interest	625		
Jan. 4	Miscellaneous expenses	2,491		
	Total	\$ 8,016		
Depreciation Reserve				
		Dec. 31	Depreciation Account	\$ 3,700
Dividends Declared				
		Dec. 31	Dividends	\$20,000

Profit and Loss			
Dec. 31	Dividends	\$20,000	Dec. 31 Profit on Sales \$42,311
Dec. 31	Surplus	22,361	Interest Received 50
	Total	\$42,361	Total \$42,361

Work in Process			
July 1-Dec. 31	Coal	\$ 500	Dec. 1-Dec. 31 To Finished \$16,573
July 1-Dec. 31	Materials	7,800	Goods
July 1-Dec. 31	Pay Roll	3,300	
July 1-Dec. 31	Miscellaneous Expenses	7,473	
	Total	\$19,073	
		16,573	
Dec. 31	On Hand	\$ 2,500	

Finished Goods (at Cost)			
July 1-Dec. 31	From Work in Process		July 1-Dec. 31 To Sales \$20,389
		\$16,573	
July 1-Dec. 31	From Burden	8,016	
	Total	\$24,589	
		20,389	
Dec. 31	On Hand	\$ 4,200	

THE TRIAL BALANCE

After all the entries have been made to represent adequately all these transactions and account transfers, or if, at any intermediate period such as at the end of any month, it is frequently desired to determine the status of all the transactions to date or to "close the books" and continue from known previous balances, such a process is called "striking a trial balance."

A *trial balance* is simply a list and summary of the balances (debit and credit, respectively) of all the ledger accounts as of a certain date. The trial balance of the ledger accounts for the transactions of this illustrative problem, as of Jan. 1, 1937, is shown below:

Trial Balance	DEBIT	CREDIT
Cash	\$110,161	
Proprietorship		\$150,000
Physical Plant	85,000	
Notes Payable		\$ 10,000
Insurance Prepaid	100	
Stores	2,200	
C Co.		2,000
D Co.	5,000	
Interest In		50
Profit and Loss		22,361
Dividends Declared		20,000
Taxes Accrued		1,100
Depreciation Reserve		3,700
Work in Process	2,500	
Finished Foods	4,200	
		<hr/>
	\$209,161	\$209,161

Such a balance is of value for the following principal reasons:

1. It proves whether or not the ledger accounts, as previously posted, actually balance at any particular date.
2. It provides information regarding assets, liabilities, and capital in a more convenient form than the ledger itself for:
 - a. Preparation of financial statements.
 - b. Closing of the ledger.
3. It is useful in indicating the following errors:
 - a. Omission of posting an entry.
 - b. Posting an entry twice upon the same side of an account.
 - c. Posting an entry on the wrong side of an account.
4. It furnishes a concise list of debit and credit balances of accounts of the ledger as of a certain date which may be compared (with those of other dates) to the advantage of the executive.

Of course, the debit and credit balances should be identical since two equal entries should have been made for every transaction. This process is therefore a partial check upon the accuracy of the entries and the posting, although it is obvious that certain errors will not be disclosed in this account. The following possibilities of errors and the failure of their detection by means of the trial balance will be readily recognized:

1. An error which, although posted to the right side of the ledger, is posted to the wrong account.

2. Errors in mathematical operations which occurred on the books of original entry and have been carried forward thus into the ledger.
3. Posting transposed figures to both sides of a ledger account.
4. Omission of entire business transactions.
5. Overdebiting one account and underdebiting another, providing the amount of the overdebit equals the amount of the underdebit.
6. Similar errors in overcrediting and undercrediting any accounts.

THE WORK SHEET

Many adjustments, particularly involving intangible items, must be made between the trial balance, the profit and loss statement, and balance sheet, the latter two summaries being the goals of the executive for the accounting system. Corrections in the trial balance and the separation of profit and loss items from those representing the true assets and liabilities of the balance sheet are readily made upon the so-called *work sheet*. Such a sheet, which, like the trial balance, is simply a bookkeeping tool, may take various forms in different accounting systems, but in general it should provide the ready addition or subtraction of items indicated in the following columns:

Items	Trial Balance		Adjustments		Adjusted Trial Balance		Balance Sheet		Profit and Loss	
	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.

The following paragraphs, quoted from "How to Understand Accounting" by Greer,¹ represent a most concise statement of the various adjustments, often rather intangible to the novice, which have to be made most frequently upon such a work sheet.

The trial balance of the ledger at the end of a month furnishes a starting point for the calculation. Purchases and sales, cash receipts and payments, and any other visible transactions have already been given expression. The items usually or frequently requiring further adjusting entries may be indicated.

1. The cost of merchandise sold must be separated from the cost of merchandise remaining on hand. Although the sale of merchandise is a plainly "visible" transaction, there is in many cases no record made

of anything but the selling price. If the cost of goods sold is recorded currently, no month-end adjustment is necessary, but, if not, the cost of all merchandise purchased will remain in one account until it is determined how much of it is still an asset and how much has become an expense through transfer to customers.

2. In a manufacturing plant the merchandise consists of materials, work in process, finished goods, and perhaps other items. The value of manufactured and partly manufactured goods consists in part of labor and expenses. Where a perpetual-inventory cost system is in effect, these values are automatically produced on the books, but this involves the recording of all transfers of materials, labor, and product within the factory as they take place. Where cost-accounting methods are absent, the cost of goods sold must be figured at the end of the period by considering material, labor, and expense purchases and the value of inventories remaining on hand.

3. Expenses of operation are frequently paid for periods considerably beyond the current one. At the end of any period a separation must be made between the portion of the payment applying as an expense of the current period and the portion prepaid for future periods (for the present an asset, for future consumption). Insurance premiums furnish a common example of this type of item; factory and office supplies on hand are others.

4. Expenses of operation are, on the other hand, often incurred before they are paid; they sometimes continue to accrue for several periods before payment finally becomes due. In this case the month-end adjustment consists of a recognition of the liability and of the expense it represents. Property taxes are a common example of this type of item; there are many other temporary accruals of expense, such as wages, interest, etc.

5. Income is frequently realized from sources other than sales, and when there is such income it may accrue before it is collected or even falls due. An adjustment then must be made to recognize the asset, "accrued income," and the corresponding addition to profits, under whatever title it may appear. Interest on loans and investments is often of this class.

6. Income may, obviously, also be collected before it is due and before performance of the service by which it will be earned. This gives rise to an item called "deferred income," which is set up as a quasi-liability with a corresponding deduction from profits. Interest on loans often requires such adjustment on the books of financial institutions.

7. Fixed assets (i.e., the semipermanent physical properties with which operations are carried on) are subject to wear and tear, obsolescence, and other factors of deterioration. As a result it becomes neces-

sary to write off or "amortize" their cost over their probable useful life. An adjustment must be made at the end of each period to take account of this depreciation, the value expired being treated as an expense and as a deduction from the asset depreciated. The latter half of the adjustment is frequently carried into a separate account called Reserve for Depreciation, as noted in a later section.

8. Similar adjustment must be made for amounts consumed in the case of wasting assets such as minerals, timber, etc. The write-off is in this case usually called Depletion instead of Depreciation.

9. The total of amounts due from customers and others may require to be reduced to the extent of uncollectible accounts and notes carried on the books. A charge is made to an expense account called Bad Debt Losses, with a corresponding credit either to customers' accounts or to a Reserve for Bad Debts.

10. It is assumed that all ordinary liabilities will have been set up on the books in the regular course of recording merchandise purchases, expenses, etc. It happens occasionally, however, that some are overlooked, in which case an adjustment must be made to take the omitted items into the accounts. The result will be an addition to expenses, purchases, or other income reduction account. The same sort of omission might occur in the case of an asset item, in which event the result would be an addition to income or a deduction from expense; such omissions are, however, rather rare.

INVENTORY AT COST*

Whether the items included in this problem under such ledger accounts as Stores, Work in Process, Finished Goods, and Merchandise Sales are found in the general ledger of a small combined manufacturing and sales organization, in the subsidiary ledgers of the large corporation, or only in the largest factory cost-accounting records, they may be summarized at the end of the month, or any other desired period, into an "inventory at cost" account or into a report which may be checked with the physical inventory or perpetual inventory, and thereby prove to be a record of great importance and value to the executives of the company.

Such accounts, when checked, should satisfy the equation for cost accounting:

$$\text{Initial inventory} + \text{purchases} - \text{final inventory} = \text{cost of goods sold}$$

* See also Chaps. IX and XVII.

INCOME STATEMENT OR EXPENSE ACCOUNT*

Another very important derived financial report available from the control ledger or, better, from the trial balance and work sheet is the *income statement* or *expense account*, which is sometimes unfortunately described as a "profit and loss statement." The latter term, although a correct description of the content of the account, is too often and too easily confused with the Profit and Loss Account of the ledger. The latter is simply one of many ledger accounts, as indicated in the foregoing problem, and does not provide the items of Gross Revenue, Expense, and Net Income which form such valuable information to the general manager.

As a concrete example of an adequate income statement for the period of transactions of the above illustrative problem, the following will be readily derived by the reader:

Income Statement July 1 to Dec. 31, 1936		
Sales		\$66,000
Other Revenue		50
		<hr/>
		\$66,050
Cost of Production:		
Raw Materials Inventory July 1		None
Raw Materials Purchased		10,000
		<hr/>
		\$10,000
Raw Materials Inventory Dec. 31		2,200
		<hr/>
Cost Raw Materials Used		\$ 7,800
Factory Labor		\$3,300
Heat, Light, and Power		8,864
Coal		500
Repairs		1,100
		<hr/>
		\$13,764
		<hr/>
Goods in Process July 1		None
Goods in Process Dec. 31		\$2,500
		<hr/>
Cost of Goods Manufactured		2,500
		<hr/>
		\$19,064

* The balance sheet for the period under consideration in this problem may be found in Chap. XIX, p. 368.

Brought Forward		\$19,064	\$66,050
Finished Goods Inventory July 1	None		
Finished Goods Inventory Dec. 31	4,200	4,200	
Cost of Goods Sold			14,864
Gross Profit on Sales			\$51,186
Selling Expense {	3,300		
Administrative Expense {			
Insurance	100		
Taxes	1,100		
Depreciation	3,700		
Interest	625		
			8,825
Net Profit			\$42,361
Dividends Paid			20,000
Income in Surplus			\$22,361

The process of doing any kind of business is that of securing a certain Gross Revenue, the subtraction of a certain Expense necessarily associated with the doing of the business, and the determination of the result in the form of Net Income. This is true, regardless of whether the business is the sale of services, such as the average public utility corporation, the purchase and sale of commodities (merchandising), or the manufacturing of raw materials into and the wholesaling of the finished product. The income statement sets forth the summary of such items, for any type of business, although the problem of classifying the various units of expense may be rather complex. The proper place to determine and allocate such expenditures is at their source; hence the necessity of rather elaborate systems of accounts to one of which each expenditure may be most appropriately charged.

Broadly stated, then, expenses may be considered as "assets used up" in the operations of the business. The acquisition of assets (property or right of service) by a company anticipates an expense later which will consume at least part of the assets in producing net income.

Expenses incident to manufacturing gradually contribute to the cost of the manufactured product; they apply against gross revenue to produce net income only as the product is sold. Such

are involved in cost accounting. Selling and administration expenses, on the other hand, are usually charged off against the sales income of the period in which they are incurred, instead of being added to the cost of the product during the manufacturing period.

To determine the correct period within which to consider such an expense, which involves an estimate of the extent to which an asset may have been used up, is often one of the most difficult problems of accounting. The lease of a building or a contract with employees is usually exact expense, as of a certain definite period, but, if an engineer is to state what portion of the value of a boiler or a steam turboalternator is to be charged off the first year of its operation, he is confronted with many methods of possible estimate and many schools of thought^{2,3} (see also Chaps. X and XVIII).

Many of the former temporary purchases, such as materials, equipment, rent, labor, power, etc., particularly if they are to be consumed within the year, are more simply considered as operating expenses and never capitalized as assets to be later "charged off" to expense accounts, while depreciation reserves must be set up, usually annually or quarterly, to provide out of gross revenue an adequate amount to make up for the depreciation (including obsolescence) of the larger capital asset values such as buildings, machinery, and the longer-lived equipment. In some accounting systems, therefore, expense accounts are adjusted from time to time to make up for overcharges or undercharges for any one period, while in other systems only after an asset has been consumed or transferred is its proper value written off to the expense account.

Specific References

1. GREER, HOWARD C., C.P.A.: "How to Understand Accounting," Ronald Press Company, New York.
2. COLEMAN, E. P.: "Retirement vs. Depreciation Accounting," *Elec. World*, May 19, 1934.
3. THOMPSON, C. W.: "Depreciation Accounting Favored," *Elec. World*, July 14, 1934.

General References

- BENNETT, R. J., C.P.A.: "Corporation Accounting," Ronald Press Company, New York.

- KOHLER, ERIC L., and PAUL L. MORRISON: "Principles of Accounting," McGraw-Hill Book Company, Inc., New York.
- KOOPMAN, S. B., and R. B. KESTER: "Fundamentals of Accounting," Ronald Press Company, New York.
- LAWRENCE, W. B.: "Cost Accounting," Prentice-Hall, Inc., New York.
- MONTGOMERY, R. H.: "Financial Handbook," Ronald Press Company, New York.
- SALIERS, E. A.: "Accountant's Handbook," Ronald Press Company, New York.

Review Questions

1. a. What is the rule for posting debits and credits in the ledger?
 b. State two methods of obtaining a trial balance and their purpose.
 c. Are assets debit or credit balances?
 d. Will profits show upon the balance sheet as a liability or an asset?
 e. What is the function of the bookkeeper, the accountant, and the auditor?
2. If items of merchandise *a* are sold for cash @ \$500, *b* sold on account to B Company for \$600, and *c* purchased of C Company on account for \$1,000, respectively, would such transactions be entered in cash and ledger accounts? If so, how?
3. Show how entries (a) and (b) would be made in the accounts of Interest Payable, Burden, Cash, and Profit and Loss and how those accounts would appear at the end of the period as far as these entries are concerned.

a. Mar. 1 Interest accrued (outgoing) but not paid	\$200.00
b. Mar. 2 Interest paid on above	\$100.00
4. Open the necessary ledger accounts of A Company and strike the trial balance for the following transactions:

Dec. 1 A Co. begins business with \$100,000 cash capital	
Dec. 2 Buys raw materials for cash \$50,000	
Dec. 3 Buys raw materials on account from B Co. \$70,000	
Dec. 4 Gives B Co. note for \$60,000 on account	
Dec. 4 Pays \$10,000 cash for wages of employees	
Dec. 5 Sells product on account to C Co. for \$80,000	
Dec. 10 Receives from C Co. partial cash payment on account \$40,000	
5. The following transactions, dates, and accounts of A Co. are:

Dec. 1	Cash on hand at beginning of period	\$50,000
Dec. 2	Purchased raw material for cash	10,000
Dec. 31	Paid power bill for month in cash	4,000
Dec. 31	Paid pay roll for month in cash	12,000
Dec. 31	Accrued miscellaneous overhead expense paid in cash	6,000
Dec. 31	Sold 1,200 finished units at \$40 each for cash	48,000

Dec. 31	Inventory of finished units on hand at cost	400 at \$20	8,000
Dec. 31	Work in process inventory		None
Dec. 31	Raw material stores inventory		None

Accounts to be opened and balanced for these transactions are: Proprietorship, Cash, Raw Material Stores, Work in Process, Burden, Finished Goods, Sales, and Profit and Loss. Make the proper double entries specifying dates for these transactions; balance each account and show the trial balance.

6. a. Given the following transactions as journal entries, post the necessary double entries to the necessary ledger accounts for the month of July.
 b. Close the ledger and take off the trial balance.

July 1	Start contracting and electrical merchandise business with cash capital	\$10,000
July 2	Employ 2 assistants \$100 per month each and pay cash last day of month	200
July 2	Rent store paying cash \$100 for July	100
July 2	Pay cash, in advance, for 1 year insurance	60
July 5	Purchase fixtures for store for cash	1,000
July 5	Purchase wholesale merchandise on account from B Co.	2,000
July 5	Give note to B Co. on account	1,500
July 8	Pay cash on account B Co.	500
July 15	Complete 5-day contracting job for which \$100 supplies and labor of 2 assistants are used and client (C Co.) is charged (allocate burden proportional to direct labor)	300
July 30	Sell one-fourth of remaining merchandise for cash	900

7. Make the necessary double journal and ledger entries for the following transactions and draw up the trial balance.

Dec. 1	Cash on hand	\$20,000
Dec. 2	Purchased raw materials for cash	5,000
Dec. 3	Purchased raw materials on account from B Co.	2,000
Dec. 4	Paid B Co. cash on account	500
Dec. 4	Gave B Co. note for balance of account	?

8. From the following data, prepare: (a) necessary ledger accounts; (b) inventory at cost; (c) trial balance:

Jan. 1	A began business with cash	\$180,000
Jan. 4	Rented factory for cash	2,000
Jan. 6	Bought of B Co. cash 780X at 100 each	78,000
Jan. 7	Sold C Co. for cash 200X at 130 each	26,000
Jan. 8	Bought of D Co. on account 300Y at 80 each	24,000
Jan. 9	Sold to E Co. on account 50X at 130 each	6,500
Jan. 9	Sold to E Co. on account 70Y at 107.14	7,500
Jan. 12	Gave D Co. note for 5 days	15,000
Jan. 14	Received of E Co. note for 60 days	10,000

Jan. 17	Paid D Co. cash for 5-day note	15,000
Jan. 22	Sold F Co. for cash 100X at 130.00	13,000
Jan. 24	Sold F Co. account 80Y at 112.50	9,000
Jan. 30	Paid light and power bill cash	1,000
Jan. 31	A drew salary	1,000

9. Open the necessary cash-book and ledger accounts to provide for adequate double-entry accounting of the following transactions and prepare a trial balance.

Dec. 1	Begin business with cash capital from sale of common stock of	\$200,000.00
Dec. 2	Purchase store building with cash payment of	40,000.00
Dec. 2	Purchase merchandise for cash (A)	4,000.00
	(B)	5,000.00
	(C)	41,000.00
Dec. 3	Employ clerks for month	1,250.00
Dec. 16	Sell A merchandise for cash	5,000.00
Dec. 16	Sell B merchandise on account to H Co. for	7,000.00
Dec. 23	H Co. gives note for partial payment on account	6,000.00
Dec. 23	Pay cash for light and power	450.00
Dec. 23	Pay clerks for month in cash	1,250.00

10. Transactions of A Company for January:

Jan. 1	Owners put up cash amounting to	\$25,000
Jan. 2	Purchase building for cash	5,000
Jan. 2	Purchase raw materials from B Co. on account for	2,500
Jan. 30	Sold 500 finished units on account to C Co. for	5,000
Jan. 31	Paid power bill for January in cash	500
Jan. 31	Paid direct labor bill for January in cash	1,000
Jan. 31	Paid for miscellaneous expense in cash	500
	Cost of raw materials used in January	\$2,000
	Inventory of work in process at cost	500
	Inventory of finished goods at cost	100

Open the necessary ledger accounts and post the above transactions.

11. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

- T F The trial balance will make it possible to detect an error due to the entry of the correct amount on the proper side of the wrong account.
- T F The trial balance will make it possible to detect an error in addition or subtraction made in balances of accounts whose entries have been correctly located.
- T F The trial balance is a test of the accuracy of all bookkeeping entries.
- T F Dividends that have been declared but not paid are liabilities of the company.
- T F An account that is settled by means of a note immediately affects the cash account.

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- T F Balance sheet and trial balance totals for a particular company are always the same for the same period of time.*
- T F The proprietorship account is commonly found in the income statement.
- T F The trial balance determines the balances in all ledger accounts.
- T F The income statement and the profit and loss account are identical.
- T F All accounts in the ledger appear on the trial balance.
- T F Accounts balanced within the period appear in the Trial Balance.
- T F Single-entry bookkeeping lends itself readily to large corporate business.
- T F Cash payments, outgoing, are credited to the Cash Account.
- T F Purchase of equipment debits Physical Plant Account.
- T F An outstanding note, owed by the company whose accounts are being considered, is debited to the Notes Payable Account when it is paid.

* See Chap. XIX.

CHAPTER XVII

COST ACCOUNTING

Now that the principles of general accounting have been explained, the specialized branch known as cost accounting will be outlined in sufficient detail to enable the engineer to analyze its applications to economic problems of engineering and management.

Cost accounting is a method of recording and summarizing the costs of raw materials, the expense of labor (direct and indirect), and the overhead charges incurred by a manufacturer or public service corporation during the process of manufacture of an article or the rendering of a public service, in order to ascertain the total cost of such merchandise manufactured or such service rendered and the unit cost of each. The merchant buys merchandise in the same form in which he sells it; hence he can readily ascertain the total cost or the unit cost from the record of purchases and purchase invoices or from his inventories. The manufacturer and the public utility corporation buy raw materials and through manufacturing processes alter them to meet the requirements of customers.

Cost accounting primarily consists of a more detailed consideration of the portions of general accounting which have been designated as Work in Process and Overhead or Fixed Charges (during the process period). Such Overhead or Fixed Charges not immediately associated with the manufacturing process are frequently designated as Burden.

The principal items to be considered in the cost-accounting process are materials, labor (direct and indirect), operating expenses, and burden. The equitable allocation of burden to the proper accounts provides one of the most difficult problems in cost accounting. Probably more discussion and more differences of opinion have been expended upon this one subject than upon all other phases of cost accounting.

Before proceeding further, it is necessary to define some of the more common terms used by the cost accountant.

Prime Cost.—The sum of the costs of raw materials and the expense of labor thereon in the manufacture of an article is referred to as the *prime cost* of the article.

Factory Cost.—The sum of the prime cost (materials and labor) and the cost of burden (properly allocated) in the manufacture of an article is referred to as the *factory cost* of the article, thus:

$$\begin{aligned}\text{Materials cost} + \text{labor expense} &= \text{prime cost} \\ \text{Prime cost} + \text{burden expense} &= \text{factory cost}\end{aligned}$$

Cost Period.¹—Since the manufacturer needs to know the cost of his goods as quickly as possible after manufacturing is completed, it is customary to divide the fiscal year into cost periods of one month or four weeks. Thus the records show costs for each cost period and the manufacturing cost of merchandise finished during that period.

Manufacturing costs may be recorded concurrently so as to show the cost of the goods manufactured while the manufacturing process is in progress, thus providing this information regarding goods manufactured during a cost period, without waiting until the end of the cost period to ascertain it.

Cost of Finished Goods.—The cost of finished goods manufactured during any definite period would be the total raw materials, labor, and burden costs for the period, provided all materials placed in the factory for manufacturing purposes have been manufactured into finished goods. This condition, however, does not usually exist because the factory is in continuous operation; hence there is at all times more or less material in process of manufacture. For this reason it is usually necessary to take into consideration the cost of the material, labor, and burden applicable to both the completed and incompletely manufactured product in order to ascertain the cost of the finished goods. The asset value of the finished goods is the raw-materials cost, labor cost, and burden cost involved in the manufacture of the product to the point of completion. The asset value of the unfinished goods, usually referred to as *work in process*, is the raw-materials cost, labor cost, and burden cost at any time it is ascertained during the process of manufacture.

The cost of the work completed during a cost period is the cost of the goods in process at the beginning of the period, plus the cost of material, labor and burden placed in process during the period, less the cost of goods in process at the close of the period. The statement in the following concrete illustration shows the method of applying this to the recorded facts shown by the balances of the appropriate accounts at the close of the cost period. Each amount given in this statement is the cost price. All expenditures applicable to the manufacturing process

are regarded as an exchange of an asset for a cost; hence the final result is the asset value based on the cost of the finished product.

Work in Process, May 1.....	\$ 2,000
Material Placed in Process during May.....	8,000
Labor on Material in Process.....	6,000
Burden Applicable to Work in Process.....	5,000

Total Cost.....	\$21,000
Less Work in Process, May 31.....	2,500

Cost of Finished Goods.....	\$18,500 ¹

Whether one is involved in merchandising, public utility service, or manufacturing, the progress of the raw materials or incoming goods must be followed through the various processes tending to increase their value until the sale and its adequate profit are recorded. This procedure involves some form of inventory of both raw materials and finished product. The necessary periodical physical inventory and the many advantages of the perpetual inventory of goods on hand, whether they are raw materials or finished products ready for sale, were presented in Chap. IX.

With the principle of the perpetual inventory established, therefore, the problem of cost accounting represents an expansion thereof to meet the more complex additions to the value of the work in process as it proceeds through the factory. Goods or raw materials purchased are considered as assets and therefore debited to the proper materials account; whatever portion is placed in the manufacturing process or that which is sold is treated either as assets consumed or as an expense. Labor and expense of processing are considered as adding to the value of the asset. Not until the goods are finally sold is any expense (in the sense of a charge against sales revenues) recognized in these accounts. When the sale takes place, the accumulated cost of the manufactured product is written off as the cost of goods sold.

When the manufacturing process begins, the raw materials necessary therefor are credited out of Materials on Hand and charged to the Work in Process (usually upon a specific work order bearing a job number looking ultimately toward a specific product, such as radio receiver, K-11, or six-cylinder sedan, type S-12, etc.). To this account are charged, in addition, the labor

pay roll utilized in manufacture as direct labor, and indirectly such items incident to manufacture as rent, light, heat, power, shop supplies consumed, insurance, taxes, depreciation, etc., many of which can be only approximately allocated to a particular job. Therein lies the much discussed problem of burden, which is further analyzed for the electric light and power manufacturing process as the Allocation of Valuation and Fixed Charges in Chap. XVIII.

The following chart, Fig. 28,² will indicate at a glance to the engineer the gradual augmentation of value to the assets from

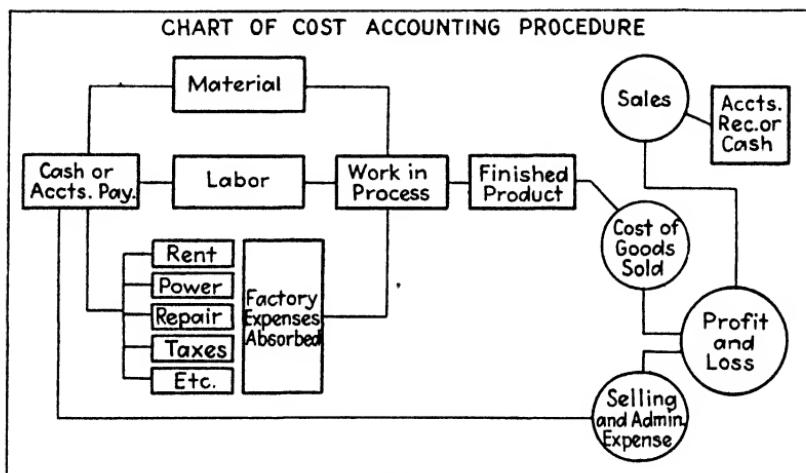


FIG. 28.—Chart of cost-accounting procedure.

the original purchase of raw materials up to the final sale of the finished product.

Although the cost-accounting system for a line of automobiles or radio receiving sets, with their thousands of subordinate parts and processes entering into the finished product, is vastly more complex than that for a process wherein the individual elements have no possibility of distinction one from the other, such as kilowatt-hours of electric energy, cubic feet of artificial gas, or tons of ice, yet the underlying principles of cost accounting used in the two cases may be identical if applied to the units of the system.

Card records³ similar to the following, Fig. 29, may readily be prepared for each department, and these will enable the product

and its cost to be followed through the various processing operations as the result of the application of such additional forms as requisitions, completed order notices, etc.

In order to provide adequately for the addition of the costs of labor and burden, however, one of the following methods, or a

MATERIALS STOCK CARD

Material C.R. Stock.. Size.....1"				Stock No. A-562			
Location: Store Room.. R.ack... Bl. 22. Max.... Min....							
Received				Disbursed			
Date	Reference	Quant.	Cost	U.P.	Date	Reference	Quant.
5/4	V6 2970	510	-165	0.912	5/10	R-4617	400
6/1	V6 1331	540	2270	0.920	7/2	R-5855	600
7/2	V6 1484	380	-1562	0.911			

COST SHEET

Quantity	100	Item	<i>Staff Sash Assembly</i>	Order No.	1666	
Drawing No.	7-57W	Dept.	Mach. Shop	Staff Assm.	Date	1/20/47
Authorized By	<i>Trembl</i>	Date Promised	1/21	Date Finished	1/21	
Deliver To	<i>Conn. Stk.</i>	Charge Account	31-8			
Materials	Labor	Burden				
600# CR Stl. 25.32	Pay Roll <i>summa</i> 7.55.10	Payroll <i>summa</i> 7.58.61				
100 brass 12.00	- - - - -	Std 17.00 Std 21.12				
Total Cost of Order	276.10	No. Pcs. Finished	100	Cost per Piece	2.76	

PRODUCT STOCK CARD

FIG. 29.—Cost-accounting record cards.

combination of two or more, should be considered. A concrete example may best be used to illustrate the various applications, the selection of the most desirable method being dependent upon the variety of the processes involved and the legitimate clerical detail that may be warranted to secure a higher degree of accuracy of allocation.

Typical Methods of Burden Determination and Allocation.

Plant has invested capital of..... \$100,000

Plant has annual expenses including
overhead and depreciation of..... \$200,000

Annual expenditures for burden made up as follows:

F^1 Interest 5% on \$100,000.....	\$ 5,000
F^2 Taxes, Insurance, and Depreciation.....	10,000
F^3 Salaries.....	15,000
F^4 Indirect Labor.....	15,000
For V^1 Interest on Borrowed Money.....	
V^2 Maintenance.....	5,000
V^3 Indirect Labor.....	20,000
V^4 Fuel, Supplies, and Shrinkage.....	10,000

Total Burden.....	\$ 80,000
Total Direct Labor.....	100,000
Total Material.....	20,000

Total factory cost of product.....	\$200,000

F Items Independent of Volume of Product

V Items Vary with Volume of Product

Method 1.—Add 80 per cent of direct-labor cost to direct-labor cost on all products since total burden (\$80,000) is found to be 80 per cent of total direct labor (\$100,000). This is close enough with a uniform product of a few pieces and with uniform wages and machine sizes.

If we assume a journeyman at \$12 per day with one apprentice at \$3 per day, the per diem charge for their work by this method would be:

$$\text{Journeyman } \$12.00 + \$9.60 = \$21.60$$

$$\text{Apprentice } \$ 3.00 + \$2.40 = \$ 5.40$$

$$\text{Total} \underline{\hspace{1cm}} \quad \$27.00$$

Method 2 (Man-hour Distribution).—Assume 53 employees working approximately 2,500 hr. each per year, say, 133,300 man-hours total; or $\$100,000/133,300 = \0.75 per man-hour for direct labor.

$$80\% \text{ for burden is } \frac{\$80,000}{133,300} = \$0.60 \text{ per man-hour}$$

When wage rates and machine sizes vary, this charge per man-hour is more equitable: on this basis the per diem charge for the two men working together would be for a 10-hr. day:

Journeyman	\$12.00 + 10 × \$0.60	= \$18.00
Apprentice	\$ 3.00 + \$6.00	= \$ 9.00
Total		\$27.00

It will be noted that the burden for the apprentice is double the direct-labor expense while in the case of the journeyman it represents only 50 per cent of direct labor.

Method 3.—Although method 2 is a little more equitable, yet the apprentice usually involves more burden per hour than the skilled workman and a ratio based upon a local study of shop conditions, such as the following, might well be adopted, keeping the total \$0.60 per hour for each man or \$1.20 per hour for the two:

Journeyman	\$12.00 + \$0.45 × 10	= \$16.50
Apprentice	\$ 3.00 + \$0.75 × 10	= \$10.50
Total		\$27.00

In this method various burden rates may be determined for different classes of employees or for employees in different departments. Its chief disadvantage lies in the extra clerical work required to secure the necessary ratios with sufficient accuracy.

Factors Affecting Burden.—Before we break down unit burden items into greater detail, it may be well to survey the following conditions which may affect such departmental burden and cause it to change its ratio of allocation from season to season or from one department to another:

1. Classes and size of product; quantity in lot. Are we dealing with a turboalternator valued in hundreds of thousands of dollars which may be in process of manufacture from twelve to eighteen months or are we considering manufacturing thousands of electric lamps or radio sets each day?
2. Number of pieces in each unit or item of product.
3. Number of operations per piece.

4. Organization (line or staff, and how many manufacturing, planning, or stores departments are involved?).
5. Wage system (day, piece, or bonus).
6. Departments
 Number of machines, size, and cost.
 Frequency and cost of repairs.
 Supervision required.
7. Work standards
 Large order; men and machines suitable.
 Small rush order; machines must be readapted.
 Men unskilled or unfamiliar with new product.
 High-priced men on low-priced work (depression conditions).
8. Business Conditions
 Normal; few machines idle.
 Depression.
 Boom; overtime; rush.
 Special orders.

Method 4 (Departmental Burden).—In the following Table XXVIII the same company previously considered has its various shops and departments listed as *A*, *B*, *C*, and *D*, which must

TABLE XXVIII.—DEPARTMENTAL BURDEN

	Total	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
Items of overhead expense (see Department C, Method 7, p. 343)	\$ 5,000	\$ 1,000	\$ 1,000	\$ 2,000	\$ 1,000
10,000	1,000	1,000		5,500	2,000
15,000	2,000	3,000		9,000	1,000
15,000	3,000	1,000		4,869	6,000
5,000	1,000	1,000		2,000	1,000
20,000	4,000	3,000		10,631	3,000
10,000	3,000	2,000		2,000	3,000
Burden.....	\$ 80,000	\$15,000	\$12,000	\$ 36,000	\$17,000
Material.....	20,000	9,000	3,000	5,000	3,000
Direct labor.....	100,000	26,000	5,000	59,000	10,000
Total.....	\$200,000	\$50,000	\$20,000	\$100,000	\$30,000
Man-hours.....	133,300	34,700	6,700	78,600	13,300
Burden, per cent.....					
Direct labor.....	80	57.7	240	61	170
Burden per man-hour....	\$ 0.60	\$ 0.432	\$ 1.80	\$ 0.459	\$ 1.275

contribute to the finished product of the company. The totals previously stated are repeated in the left column and are then

broken down for the various departments. Note the variation of man-hours, the burden per man-hour, and the percentage of direct labor in the different departments. This implies that the previous general ratios may be considerably in error for any one or combination of a few departments. The question still remains, however, as to whether the detailed expense of securing these figures is justified.

Method 5 (Classes of Product).—The columns of Table XXVIII might easily have represented various classes of product through which only certain types or styles of the output of the factory pass, or they might represent departmental processes, one or more of which might be applicable to the preassembly of parts of the finished product. Man-hour allocations ranging, therefore, from \$0.432 to \$1.80 might be used.

Method 6 (Machine-rate Burden).—The machine shop (Department C) has been further analyzed in Table XXIX with respect to (1) number and type of machines, (2) value of each machine (original cost, present, book, or reproduction value should be stated), (3) interest, taxes, and depreciation in per cent and total dollars per annum, (4) working hours of each machine per year, (5) rated motor horsepower of each machine, (6) power expense per annum at 2 cts. per horsepower-hour, (7) floor area occupied by each machine including that required for operator, material, working space, and passageways, (8) rental of space per annum at 50 cts. per square foot, (9) summation of costs from columns 3, 6, and 8, (10) machine-hour cost, (11) total machine-rate burden based on machine-hour allocation, (12) total machine-rate burden based on machine and man-hour allocation.

Although the detailed allocation in this case affects only an item of \$4,869 out of \$36,000 of burden in this one department and an approximation therein therefore would introduce only a small percentage error, yet the method is justifiable in many other instances wherein machine burdens represent a large portion of the total.

The unit figures used in this example should not be considered as typical or standard, but they are representative of one case only. Such unit costs are usually readily determined for the particular company and department under consideration.

Method 7 (Modified Machine-rate Burden).—If the excess of burden, in this case \$36,000 - \$4,869 = \$31,131, is analyzed

TABLE XXIX.—MACHINE-RATE BURDEN

Machine (1)	Value (2)	Int. tax dep. (3)	Working hr. per yr. (4)	Hp. each (5)	Hp. cost per yr. (6)	Sq. ft. space (7)	Cost of space, 50 cts. per sq. ft., per yr. (8)	Sum (3) + (6) + (8) (9)	Sum + hr. per yr.* (10)	Sum + hr. per yr.* (11)	Hourly burden† rate (12)
1 boring mill.....	\$5,000	10 %	\$500	1,000	10	\$200	384	\$192	\$892	\$0.89 + 0.48 = \$1.37	or \$1.29
1 planer.....	1,000	15 %	160	1,500	5	160	155	78	378	0.25 + 0.48 = 0.73	or 0.65
4 lathes.....	1,500	12 %	180	2,000	10	400	193	96	676	0.34 + 0.48 = 0.82	or 0.74
10 small machines, average.....	100	10 %	10	2,500	0.5	25	40	20	55	0.02 + 0.48 = 0.50	or 0.42
15 benches and fittings.....	30	10 %	3	2,000	....	....	40	20	23	0.01 + 0.48 = 0.49	or 0.41
Total.....	.....	.....	.....	65,500	.....	.....	.....	.....	.....	.....	.....

Floor space = that occupied by machine, passage, operator, and material.

Cost of space = rent, heat, light, cleaning at 50 cts. per square foot per year.

Of the total burden of \$80,000, \$36,000 is assigned to the machine shop for burden.

Direct labor = \$59,000.

Total of column 9 above (taking duplicate machines into account) = \$4,869.

$$\frac{\$36,000 - \$4,869}{65,500} = 47.6 \text{ cts. per machine-hour.}$$

* This is to be added to direct labor cost and machine charge (column 10), or, better, $\frac{\$36,000 - \$4,869}{78,600} = 39.6 \text{ cts. say, 40 cts. per man-hour, to be added to column 10 to make column 12.}$

still further, the following subdivisions thereof appear as in Table XXIX, Department *C*, described below.

Planning.....	\$ 2,000
Development.....	5,500
Superintendence.....	9,000
Watchmen and janitor.....	2,000
Toolmakers.....	10,631
Repairs.....	2,000
 Total.....	 <hr/> \$31,131

Suppose a job is being estimated or allocated in which no planning and development have been involved in advance of entry into production; the items of $\$2,000 + \$5,500 = \$7,500$ may be omitted from the allocation and a machine-hour rate of $\frac{\$31,131 - \$7,500}{\$31,131} = \0.348 , say, 35 cts. per machine-hour, is used instead.

On some other job the excess, or

$$2 \times (\$0.48 - \$0.35) = 26 \text{ cts.},$$

might be justifiably added to maintain the required average for the entire factory.

Thus a modified machine-hour rate may become a special job-burden allocation.

Other methods frequently adopted in order best to meet the particular condition at hand are:

Prime-cost Method.—Wherein the burden is added to the process or production order as the percentage which the total burden for the cost period bears to total prime cost of the products manufactured during that same cost period.

Estimated-rate Method.—When it is necessary to allocate burden *at the time the work is completed*, and before the end of a cost period, an estimated percentage based upon comparative costs during previous cost periods is, of course, the only alternative.

Departmental Burden Methods.—Burden varying with the departments involved and the percentage of time the product or any portion thereof is being operated upon by any particular department may be allocated on the basis of (1) floor space occupied by the department expressed as a ratio to the entire factory floor space, (2) value of fixed assets in the department,

(3) horsepower of the machines used, (4) number of employees per department.

Miscellaneous Methods.—In an actual burden distribution of a large printing establishment having a cost-accounting system which has frequently been used as a typical case, the following allocations of burden prevailed:

1. Ratio of fixed assets of machine composition department to total fixed assets of plant.
2. Insurance premiums for year allocated in proportion to insured valuation of department to total insured valuation of plant.
3. Taxes apportioned in ratio of taxable valuation of plant.
4. Liability insurance allocated on basis of ratio of employees of department to total employees of company protected under the compensation act.
5. Rent is allocated upon the ratio of floor areas expressed in square feet per department.
6. Depreciation per month is one-twelfth of the estimated annual depreciation, which is 10 per cent of cost for machines and 2 per cent of cost for supplies.
7. Burden resulting from lighting expense is allocated upon the ratio of number of lamps per department (not entirely an adequate basis).
8. Power is allocated upon a horsepower-hour basis for each department.
9. Indirect labor (foremen) is allocated on the basis of pay-roll-hours of employees under each foreman, respectively.
10. Spoilage of material is considered an item of burden chargeable to the department in which it is known to have existed.
11. General factory expense, not otherwise allocable, is applied on the same basis as the ratio of the sum of other more definitely allocated portions of the burden.
12. The ratio of front-office expense to factory expense was known to be 29 + per cent with this company. Any and all costs involving extra office overhead therefore involved a 29 per cent addition to estimated factory costs.

Over-and Under-absorbed Burden.—Since various percentages of burden have been added here and there to the various departments, the total may prove to be either greater or less than the actual total overhead or burden of the factory when checked with the totalized accounts. The former results in a larger

profit or possibly a loss of business due to the quotation of too high a price in active competition, while the latter condition may represent a loss when a profit is expected. Many a businessman knows neither his true factory cost nor his true profit or loss. Hence the need for more careful cost accounting and particularly burden accounting.

Process and Standard Costs; Unabsorbed Costs.⁴—The sort of cost-accounting procedure just described applies primarily to that type of business in which the products have considerable individuality and costs must be cumulated separately for each. For industries, however, like the mining of coal, the milling of flour, the production of cement, etc., such methods would be fruitless. The cost of mining one particular ton of coal or milling one particular barrel of flour could not be determined except by very costly analysis and record keeping, and it would have no special significance if it were determined. What is wanted is the cost of the product as a whole—the average cost per unit manufactured.

This can be determined rather simply in most cases by merely adding all the materials, labor, and expenses for the period together and dividing the total by the number of units produced. Distinctions between direct and indirect costs are not maintained, and "orders" for given lots of product either disappear or lose most of their cost-accounting significance. The cost of the "process" and the quantity of output become the factors utilized to determine costs, this type of procedure being known as process cost accounting.

Both the order-cost and the process-cost methods as described here are essentially methods in which "actual cost" is the main concern of the accounting procedure. In some industries, however, where products are standard, and their manufacture is repeated many times without change, there seems no good reason for collecting actual detailed costs again and again on the same article, when in the nature of the case there is not likely to be any significant variation in these costs. If a "standard" or normal cost can be found for each article or process, calculations can be made on the basis of that standard and much of the detailed work of actual cost computation can be avoided.

This method was first applied to burden; standard or predetermined burden rates are used in almost all concerns. More recently it has been applied also to direct material and labor costs, until, in industries manufacturing stock products of standard design, it is now the accepted method for carrying forward the cost accounting procedure. Frequent tests are made of the standard costs; they are revised when necessary; but until there is definite evidence of a permanent change in costs, the standard figures will be used.

It is obvious that with the accounting entries made on the basis of "standard" rather than actual figures, certain discrepancies in the accounts are bound to develop. Physical inventories of raw materials, work in process, and finished product will fail to agree with the "book" figures. These discrepancies—they will be of minor amount if the standards have been carefully set—represent "underabsorbed" or "overabsorbed" cost elements, and the final statements must be adjusted to deal properly with these items.

Recent developments in the treatment of cost accounting made necessary in many industries by the greater mechanization of processes and the greater import of distribution have been most effectively outlined by Reitell as follows:⁵

First: Definite emphasis is placed upon the use of cost accounting in measuring and evaluating plant performance. . . . The cost of production has been transferred from men to machines. Intraplant problems have become of major importance and cost accounting must supply the data for the solution of such problems.

Second: Overhead expense is treated as a major item that must be rigidly controlled and kept in definite relation to production. Heretofore the cost man confined his efforts to the distribution of overhead expenses to processes and units of goods produced. The more important aspect, namely, the placing of a budgetary control over overhead expenses that will hold in check this cost element with the same rigidity that direct labor is controlled through measured allowances was neglected.

Third: Standard costs and budgets are included.

Fourth: Managerial foremanship is stressed as an important development in the use of costs. Foremen in the last analysis are responsible for a large percentage of the expenditures of an enterprise. The placing of a cost emphasis on all of their activities makes their work managerial in a restricted but definite sense. To their accustomed functions of handling men, materials, and machinery is added control of the monetary value of each.

Fifth: In costing today the same analytical treatment is applied to the marketing phases of business as to the operating and fabricating aspects.

Sixth: The important subject of the presentation of cost data for management use is treated in detail. The final success of costs depends upon the accountant's capacity to interpret costs to the executive and administrative staff.

Public Utility Costs.—Although cost systems are usually discussed in their application to manufacturing or merchandizing operations, the rigorous requirements placed by the public service

commissions of the various states upon the public utilities under their jurisdiction have made it necessary for such public utilities to adopt more detailed cost-finding methods and to report the results of those which must have been reduced to the cost of units of output such as the kilowatt-hour of electrical energy, the thousands of cubic feet of gas manufactured and delivered, etc.

The forms required by the Indiana Public Service Commission, reproduced herewith, will serve to illustrate the details and the subdivisions and classifications of accounts necessary for the determination of such unit costs. The interrelated system of accounts leading from these initial forms throughout the various voucher records to the general ledger is to be found outlined in Chaps. XVI and XXVI. In order to secure a proper allocation of direct-labor costs to the various jobs, the system of account numbers prescribed by the commission has been established as set forth in the forms of Table LIII and Fig. 40 of Chap. XXVI. Such account numbers, followed through from the initial labor item to the account of the last control-ledger entry, permit the proper total labor costs to be summarized in each department so that the cost of each process, whether it is generation, transmission, or distribution, may be determined; this cost, when divided by the kilowatt-hours of energy generated or sold, provides a unit cost, which may be compared either with other systems or with other periods of operation of the same system.

In a similar fashion, each item of material, when issued from the stock room is charged to corresponding account numbers at its cost price so that the total material cost may also be determined fairly accurately for each job and each department.

Specific References

1. BAKER, JAMES W.: "Cost Accounting," Southwestern Publishing Company, Cincinnati, Ohio.
2. GREER, HOWARD C.: "How to Understand Accounting," p. 95, Ronald Press Company, New York.
3. IBID., p. 99.
4. IBID., p. 103.
5. REITELL, CHARLES: "Cost Accounting," preface, "Principles and Methods," International Book Company, Scranton, Pa.

Review Questions

1. a. What is the purpose of cost accounting?
- b. What factors should be considered in the choice of a system of cost accounting for a given industry?
2. What are the three components of production?
3. Distinguish between direct and indirect labor.
4. Distinguish between direct and indirect materials.
5. What items make up factory cost?
6. What items make up overhead or burden?
7. What is meant by the term "prime cost"?
8. What is meant by the term "factory cost"?
9. What is meant by the following terms: (a) work in process; (b) finished goods inventory; (c) raw-material inventory; (d) cost of finished goods?

10. a. What are the advantages of the machine-hour method over the direct-labor or man-hour methods of allocating manufacturing overhead expense?

b. To what type of product would the machine-hour method be most favorably adapted?

11. The records at the end of the accounting period show the following:

Sales, 1,200 units at \$40 each.....	\$48,000
Burden.....	6,000
Finished goods, at cost (none at first of period).....	8,000
Raw material used.....	10,000
Pay roll for period.....	12,000
Power.....	\$ 4,000
Work in process.....	None

- a. How many units were manufactured during the period?
- b. What was the direct charge of manufacture per unit?
- c. What was the overhead charge per unit?

12. A radio receiver is built in four departments:

(1) Vacuum tube; (2) chassis; (3) cabinet; (4) assembly and test.

Man-hours per receiver in each department are:

(1) 2; (2) 4; (3) 5.5; (4) 10.

Average rate per man-hour in each department is:

(1) 60 cts.; (2) 40 cts.; (3) 50 cts.; (4) 60 cts.

Materials in each department are (per receiver):

(1) \$1; (2) \$3; (3) \$10; (4) \$2.

Overhead per receiver in each department is:

(1) 100 per cent of direct labor; (2) 50 per cent of materials used; (3) 25 per cent of direct labor; (4) 100 per cent of total cost, including overhead, of departments 1, 2, and 3 as receiver reaches assembly department.

Sales and front-office overhead are equal to factory cost after assembly including factory overhead. Assuming 25 per cent profit, what should be the selling price of receiver?

13. A manufacturing company has, in the following shop accounts as entries, charged out to product sold during the past six months: Materials, \$5,000; Pay Roll in Shop, \$2,500; General Expenses, \$1,500; Sales Pay Roll, \$10,000; if the general expenses are allocated between shop cost of shop product and sales in proportion to shop and sales pay rolls, respectively:

- a. What is the shop cost of the product?
- b. If the profit is estimated as 25 per cent of the shop cost, what is the total received from sales?

CHAPTER XVIII

ALLOCATION OF VALUATION AND FIXED CHARGES

In Chap. XI on The Process of Valuation, it was explained that the rate base was necessarily established in order to apply percentages of certain fixed or overhead charges to provide a "fair return" to form a portion of the annual gross revenue. This will be discussed in greater detail in Chaps. XX, XXI, and XXVIII. However, the total valuation and the accompanying percentage of fixed charges of the entire corporation may apply to several subsidiary divisions or departments of the business, or, in the case of public utility corporations, to several towns and cities in one distribution system, or to several groups of consumers having similar demands within a given community.

Where competition exists, as in a manufacturing or merchandising corporation, the selling prices are usually based upon *values* of the product or service, or, in other words, "what the traffic (purchaser) will bear." However, the factory and selling *costs* must be accurately known and the *overhead charges* allocated as *unit burden* to the different departments and processes, and often to large individual products themselves, such as the burden of a particular type of automobile, generator, engine, etc. Such allocation was described in the Chap. XVII on Cost Accounting.

Again, as a general illustration of such needed allocation of fixed charges, consider railroad operation. There are certain operating expenses such as fuel, water, labor on trains, labor in roundhouses, etc., which are approximately proportional to the service rendered measured in mileage, ton-mileage, etc., of trains operated. However, the fixed charges, based upon a certain percentage of valuation, such as interest, taxes, insurance, depreciation, etc., and other overhead expenses, such as office, clerical, executives salaries, etc., are not proportional to service rendered as measured by mileage or ton-mileage of train operation. Yet these latter charges must be properly allocated to the various divisions of the railroad and to freight and passenger service,

respectively, if the proper charges are to be made for freight and passenger transportation and if resulting profits or deficits in each department are to be correctly ascertained.

As an example of *how not to make* such an allocation, one should consider the effect of following the easiest policy of dividing the total fixed charges in proportion to the gross revenue that has been earned in the past by each department. It is obvious to all that the overhead charges for freight service are not so much greater than the overhead for passenger service as the ratio of freight to passenger gross revenue would indicate. Furthermore, such an allocation, although sometimes used, is subject to any errors that may have resulted from former determinations of gross revenue.

Examples of the electric light and power allocations are represented by the groups of consumers known as (1) commercial light

TABLE XXX.—DAILY LOAD DISTRIBUTION

Class	Maximum demand, per cent of group peak	Hours on station peak	Hours off station peak	Hours total per day
A	45	2	..	2
B	{ 30 10	2 ..	.. 10	{ 12
C	15	2	22	24
D	2	..	20	20
E	10	..	2	2
F	{ 10 30	2 ..	.. 10	{ 12

and power, (2) residential, (3) electric railway, (4) municipal street lighting, etc. Each of these groups, if supplied with service from a single corporation or network of distribution systems whose valuation has been determined, will usually have different portions of such a valuation and of the resultant fixed charges devoted to their service. Therefore, their *demand charges*, which are based upon their respective allocated fixed charges, will vary for the different groups or communities.

It becomes necessary, therefore, to find some equitable basis for prorating or allocating valuations and fixed charges to the various subdivisions of the corporation. This can best be illus-

trated by a concrete problem for the electric light and power utility as follows:

Suppose the commercial light and power group of an electric light and power utility corporation, involving fixed charges of \$632,000 per annum and a group maximum demand of 24,000 kw., is to allocate such fixed charges among six typical classes of consumers, these classes having the energy and maximum demand load curves for a typical day of the year indicated in Table XXX and Fig. 30. (A weekly or monthly chart might also be used if desired.)

It should be noted that these six classes represent practically every type of load likely to be found upon a public utility system,

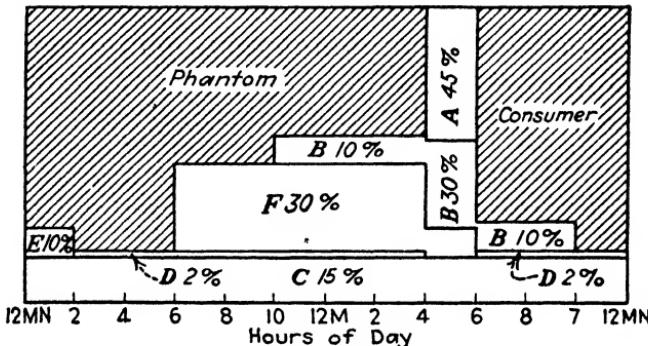


FIG. 30.—Daily square-topped load curve showing phantom class.

ranging all the way from a 100 per cent load-factor* class, such as C, to the unsatisfactory, peak-load, low load-factor class, such as A, which requires 45 per cent of the total investment for only 2 hr. use per day.

For the convenience of illustration and calculation, it has been assumed that these classes have rectangular load charts, i.e., the loads are considered as remaining constant throughout 2-hr. periods. Of course such loads, in practice, are really variable, and an average of the fluctuations for a period of fifteen or thirty minutes, which is maximum, is usually recognized as the maximum demand.

In order to visualize such a load diagram, the above figure may be built up with the long-hour classes as a base and with the central-station peak occurring between the hours of 4 and 6 P.M., a time when the power and lighting maximum demands (particularly in the winter months) are likely to overlap.

* See Chap. XXVII for these terms.

The Energy Method.—The simplest and, therefore one of the most commonly used methods allocates the fixed charges in proportion to the energy used by each class during a former

TABLE XXXI.—DAILY AND ANNUAL KILOWATT DEMAND AND KILOWATT-HOUR CONSUMPTION

Class	Maximum demand, per cent of group peak	Kw. on peak	Kw. off peak	Maximum demand, at any time	Kw.-hr. per day	Kw.-hr. per 365-day year
A	45	10,800	.....	10,800	21,600	7,884,000
B	30, 10	7,200	2,400	7,200	38,400	14,016,000
C	15	3,600	.....	3,600	86,400	31,536,000
D	2	.....	480	480	9,600	3,504,000
E	10	.....	2,400	2,400	4,800	1,752,000
F	10, 30	2,400	7,200	7,200	76,800	28,032,000
Totals	....	24,000	....	31,680	237,600	86,724,000

period, such as a typical month or year. Thus, if there are annual fixed charges of \$632,000 and the total energy used by six different classes of consumers was 86,724,000 kw.-hr. per annum, the fixed charges per kilowatt-hour would be

$$\frac{\$632,000}{86,724,000} = \$0.00728 \text{ per kilowatt-hour.}$$

Each class would then be charged with annual fixed charges represented by its annual energy use multiplied by \$0.00728.

Such a method is simple because the values of energy used by the various classes during past periods are generally available from the company books and the annual reports required by the public service commission.

The method is inequitable because fixed charges are not basically proportional to the energy used, but rather to the *maximum demand* of the class of consumers, since this maximum demand is a measure of the investment, and therefore of the fixed charges (proportional to investment or valuation) which the company must have available to serve that class when its demand occurs.

It is easy to conceive two classes of consumers, or two large individual consumers, whose maximum demands are nearly the

same and who, therefore, require about the same valuation of equipment and fixed charges for their service and yet who use vastly different amounts of energy per annum. This energy method would allocate to such consumers, widely different values of fixed charges. The class with the large use of energy would be over-burdened (see Table XXXII, page 362).

The Maximum-demand Method.—This criticism of the energy method immediately suggests that the fixed charges may be more equitably allocated by the ratio of the maximum demand of the class under consideration to the summation of the maximum demands of all classes.

This may be accomplished best by dividing the amount to be allocated (\$632,000) by the summation of the maximum demands of the classes (31,680 kw.) at whatever time they occur. For the case under consideration this amounts to

$$\frac{\$632,000}{31,680} = \$19.94 \text{ per kilowatt}$$

of maximum demands. The resultant allocation, as tabulated in column 3 of Table XXXII, page 362, is then readily found by multiplying the individual class maximum demands by \$19.94.

This plan proves to be far more equitable than the former but it has two serious disadvantages:

1. The maximum demands of classes are usually not readily obtained and, if obtained by means of special metering methods, they are subject to considerable variation from month to month and from one year to another.
2. If the maximum demands of the various classes do not occur simultaneously, and they seldom do, the summation of the maximum demands is not an accurate measure of the equipment necessary to serve such classes, for the demand upon the system at any one time may be considerably less than such a summation. In fact, the diversity factor, defined in Chap. XXVII as the ratio of the summation of several class demands to the demand at any one time upon the system, may range as high as 1.5 or 2, or between individual residential consumers and the distant power station it may even reach a 3-to-1 value. In the latter case, the equipment at the power station might serve three times the maximum demands of individual classes that are used in this method or, in other words, the allocation of fixed charges may be

very unfair to those consumers whose demands for power come at some time other than that of the maximum demand upon the station or system (see Class F, Table XXXII, page 362).

The Peak-responsibility Method.—The obvious correction of the objection to the maximum-demand method is to allocate fixed charges in proportion to the demand made by each class of consumers upon the system *at the time of the system maximum demand*. If the necessary information is at hand to determine both the magnitude and the time of the class demand, this apportionment will be found to have much merit. Such data are not frequently available, however, and therefore limit the usefulness of this plan.

In this method 24,000 kw. would be used in place of the 31,680 kw. of the previous method as the divisor. The result would be $\$632,000/24,000 = \26.33 per kilowatt of demand for station peak customers only (see Table XXXI, page 353).

Furthermore, this method has the disadvantage of increasing significance, now that many systems have two or more large demands per typical day. In this method a fairly high class demand of relatively long hourly duration, and therefore having some legitimate obligation in sharing fixed charges, is released from such charges because of the fact that its demand, although formidable, is not quite heavy enough at the time of the system maximum demand to involve its share of fixed charges. Other more detailed methods, three of which are described herein, should be used wherever the necessary records are sufficiently complete.

The Eisenmenger Method.—Summarizing a most elaborate study of central-station load charts and their relative contributions to the fixed charges of a system, which were described at length by H. E. Eisenmenger, an authority upon rates, the following simplified allocation will be found more equitable than the three previous methods, because of the fact that it takes into consideration not only the so-called on-peak but also the off-peak loads of the various consumer classes and their time of duration.¹

If we let the proportionality factors of the six classes of consumers, A through F inclusive, sharing the annual fixed charges, be represented by F_A, F_B, F_C, F_D, F_E , and F_F , respectively, and the total fixed charges be divided by their sum, then the fixed charges to be allocated to class A will be

$\frac{F_A}{F_A + F_B + F_C + F_D + F_E + F_F} \times \text{total fixed charges, etc.}$ It remains, therefore, only to find equitable values for F_A, F_B , etc.

From an elaborate graphical analysis of many load curves, the following empirical formula has been developed for determining these factors:

$$F_{\text{class}} = MD_{\text{class}} \times \frac{(1)}{\% SP_{\text{class}}} + MD_{\text{class}} \times \frac{(2)}{(100 - \% SP_{\text{class}})} \times \frac{(3)}{\frac{\text{Peak hours}}{24} + MD_{\text{class}} OP \times \frac{OP \text{ (hours)}}{24}}$$

Interpreted, this formula states that the proportionality factor for a class is equal to the sum of the following constants:

1. Maximum demand of class times percentage of station peak of class, plus:

2. Maximum demand of class times remainder percentage of station peak of class times ratio of hours per day to 24 hr. during which the class peak and station peak coincide, plus:

3. Maximum demand off peak (MD_{OP}) of class times ratio of hours per day to 24 hr. during which the class peak and station peaks do not overlap.

(1)	(2)	(3)	
$F_A = 0.45MD_A + 0.55MD_A \times \frac{1}{24} + 0 = 0.45 \times$			
$10,800 + 0.55 \times 10,800 \times \frac{1}{24} + 0$			$= 5,355$
$F_B = 0.30MD_B + 0.70MD_B \times \frac{1}{24} + 0.10SP \times$			
$1\frac{1}{24} = 0.3 \times 7200 + 0.7 \times 7,200 \times \frac{1}{24} +$			
$0.1 \times 24,000 \times 1\frac{1}{24}$			$= 3,580$
$F_C = 0.15MD_C + 0.85MD_C \times \frac{1}{24} + 0.15SP \times$			
$2\frac{1}{24} = 0.15 \times 3,600 + 0.85 \times 3,600 \times \frac{1}{24} +$			
$0.15 \times 24,000 \times 2\frac{1}{24}$			$= 4,095$
$F_D = 0 + 0 + 0.02SP \times \frac{1}{24} = 0 + 0 + 0.02 \times$			
$24,000 \times \frac{1}{24}$			$= 400$
$F_E = 0 + 0 + 0.10SP \times \frac{1}{24} = 0 + 0 + 0.10 \times$			
$24,000 \times \frac{1}{24}$			$= 200$
$F_F = 0.10MD_C + 0.90MD_C \times \frac{1}{24} + 0.30SP \times$			
$1\frac{1}{24} = 0.1 \times 2,400 + 0.9 \times 2,400 \times \frac{1}{24} +$			
$0.3 \times 24,000 \times 1\frac{1}{24}$			$= 3,420$
			$17,050$

As a further illustration, assume that the maximum demand of Class A (designated as MD_A) is 45 per cent of the station peak (SP) and is operating 2 hr. simultaneously with the station peak and that the demands of other classes are as shown in Tables XXX and XXXI. The factors of this method and the allocation of the fixed charges are, therefore, as shown at the bottom of p. 356.

Although no theoretical basis for the hourly ratios can be accurately supported for this method, it does recognize the claim of large off-peak demands upon fixed charges and approximates a composite of the probable loads of the various classes in question. The principal objections to this method are (1) it burdens rather heavily the favorable 100 per cent load-factor consumers such as Class C and (2) it is rather complicated in its calculations and requires a large amount of load data for its solution.

The Greene Method.²—Analysis of public utility accounting systems will disclose the fact that there are some operating expenses which should have a share in the demand charge.* For example, during the light-load hours of an electric power system, some operating expense is involved for stand-by personnel and for fuel and water during the period of banked fires.

The Greene method sets up two simple simultaneous equations which apply readily to such conditions and to the two and three part-rate schedules having both demand and energy charges.

$$Kx + Dy = C \quad 8,760x + y = \frac{C}{P}$$

In these equations the following symbols have been used:

x = unknown cost per kilowatt-hour of that portion of the demand costs that functions with, and in proportion to, the energy supplied to the consumer.

y = unknown demand cost per kilowatt of that portion of demand costs that functions with, and in proportion to, the consumers' maximum demand.

D = sum of consumers' maximum demands.

P = maximum coincident demand of all consumers upon the system at time of central-station peak load.

K = energy (expressed in kilowatt-hours) used by all consumers during the year.

* See Analysis of Hopkinson and Doherty Rate Schedules in Chap. XXVIII.

C = total annual fixed charges to be allocated.

8,760 = total hours per year. (This is to be replaced by the actual hours per year during which service is rendered, such as $7,392 = 308$ days times 24 in the case of power loads.)

Using the figures of Tables XXX and XXXI, the above equations become:

$$86,724,000x + 31,680y = \$632,000$$

$$8,760x + y = \frac{\$632,000}{24,000} = \$26.33$$

$$x = \$0.00106$$

$$y = \$17.05$$

Solving these equations for the only unknown quantities, x and y , for the entire system, values expressed in cents per kilowatt-hour of energy and dollars per kilowatt of maximum demand will be found which, when applied to the energy and maximum demand, respectively, of the six classes, will provide the desired allocation for each class. The summation of these allocated values for all six classes should, of course, check with the total fixed charges for the year (see column 6, Table XXXII, page 362).

This method is simple of calculation, it combines the energy and maximum-demand methods into one superior composite method, and it is fair to the 100 per cent load-factor consumer class. It has the disadvantage over the Eisenmenger method that it does not recognize the exact time with respect to the central-station peak at which the various class demands occur, although it does recognize the duration of such loads.

The Phantom Method.³—This method, proposed by H. W. Hills of the Philadelphia Electric Company, is explained in some detail because it involves several basic principles of public utility service which are also important in commission regulation and particularly in the establishment of equitable rate schedules.

If a public utility could operate steadily at its maximum demand for 24 hr. a day every day, i.e., at 100 per cent load factor, its investment in equipment would be used most economically. The fixed charges per kilowatt-hour under these conditions may

be easily calculated as $\frac{\text{Total fixed charges per annum}}{\text{Station MD} \times 24 \times 365}$.

The shaded area of the daily load chart (of Fig. 30, for example) is a measure of the failure to reach such an ideal condition and is, therefore, considered to be the energy of a fictitious or so-called *phantom-consumer class*.

The portion of the total fixed charges of such a phantom class is, under this method, added to the 100 per cent load-factor charge *in proportion to the excess of the maximum demand of each class (at the time of system maximum) above its average power.* That is to say, the extent to which each class departs from 100 per cent load-factor operation becomes a measure of its excess share in the fixed charges, since it tends to create such charges by its low-load-factor operation.

Applying Mr. Hill's principle to the group of consumers used in the preceding methods, it is evident that, if the group had been able to operate as a group at 100 per cent load factor, it would have consumed $24,000 \times 24 \times 365 = 210,240,000$ kw.-hr. per year.

The so-called phantom-consumer class is, therefore, responsible for:

$$210,240,000 - 86,724,000 = 123,516,000 \text{ kw.-hr.}$$

Operating at 100 per cent load factor, the charge for allocation would have been:

$$\frac{\$632,000}{210,240,000} = \$0.003 \text{ per kilowatt-hour}$$

The demand charge which the phantom-consumer class must add is therefore

$$123,516,000 \times \$0.003 = \$370,548$$

Since the phantom-consumer class is in reality purely imaginary, the above sum must be charged to those classes which do exist and which are responsible for the phantom class. Thus, only consumer classes that are on the station peak are involved and of those only the classes that have an excess demand over their average load. These, of course, should be charged in proportion to their excess over their average.

The calculation is made as follows:

Class A demand at time of peak.....	10,800 kw.
Average load = 21,600/24.....	900 kw.
Excess demand.....	9,900 kw.
Class B demand at time of peak.....	7,200 kw.
Average load = 38,400/24.....	1,600 kw.
Excess demand.....	5,600 kw.
Class C demand at time of peak.....	3,600 kw.
Average load = 86,400/24.....	3,600 kw.
Excess demand.....	0,000 kw.
Classes D and E are not on the peak	
Class F demand at time of peak.....	2,400 kw.
Average load = 76,800/24.....	3,200 kw.
Excess demand.....	-800 kw.

The total excess demand is $9,900 + 5,600 = 15,500$ kw.

It will be noted that the negative excess of the Class F consumers is considered as zero. The reason for this interpretation lies in the basic concept that a 100 per cent load-factor consumer is the ideal consumer. The negative excess, if carried to its logical conclusion, would result in giving Class F consumers a bonus or rebate. Although it would appear to be an advantage to induce consumers to fill in the valleys of the load curve, it might result in a shift of the station peak rather than in its elimination. In short, a 100 per cent load factor for all customers is the ideal, and to allow one class to capitalize upon the low load factor of another class is unsound and at best of only temporary advantage.

The phantom charge that has to be borne by the two remaining classes with positive excess is

$$\frac{\$370,548}{15,500} = \$23.90 \text{ per kilowatt of excess}$$

The total allocations of the \$632,000 of annual fixed charges are:

Class A:

For actual kilowatt-hours use of plant capacity	
$7,884,000 \times \$0.003$	\$ 23,652
For excess during peak $9,900 \times \$23.90$	<u>236,610</u>
Total.....	<u>\$260,262</u>

Class B:

For actual kilowatt-hours use of plant capacity =	
$14,016,000 \times \$0.003$	\$ 42,048
For excess during peak $5,600 \times \$23.90$	<u>133,840</u>
Total.....	<u>\$175,888</u>

Class C:

For use of plant capacity $31,536,000 \times \$0.003$	\$ 94,608
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Class D:

For use of plant capacity $3,504,000 \times \$0.003$	\$ 10,512
---	-----------

Class E:

For use of plant capacity $1,752,000 \times \$0.003$	\$ 5,256
---	----------

Class F:

For use of plant capacity $28,032,000 \times \$0.003$	<u>\$ 84,096</u>
--	------------------

Check on total fixed charges to be allocated...	<u>\$630,622</u>
---	------------------

Such a method, not difficult of calculation after the unit factors have been obtained, is probably the most equitable of all. It is certainly based upon sound theory and is an excellent example of the application of lowered economy in cases of low load factor.

All these six methods illustrate the contrasting claims of individual classes of consumers. Some, among themselves, have practically 100 per cent load factors, such as Class C, while others are off-peak consumer classes which, although not operating at high load factors themselves, assist in raising the load factor of the system as a whole. The relative values of these two classes to the public utility must rest upon local conditions in each case.

Calculations of the six different methods for the six classes of consumers, whose loads for a typical day were assumed in Table XXX and Table XXXI, result, in round numbers, in the following table:

TABLE XXXII.—RESULTANT ALLOCATION OF FIXED CHARGES BY THE SIX METHODS

Class	Energy	Maximum demand	Peak responsibility	Eisenmenger	Greene	Phantom
A	\$ 57,400	\$215,000	\$284,000	\$199,000	\$193,300	\$260,262
B	102,000	143,500	189,600	133,000	137,800	175,888
C	231,000	71,750	94,800	152,000	94,900	94,608
D	25,500	9,600	.....	14,800	11,900	10,512
E	12,700	48,000	.....	7,400	42,800	5,256
F	204,000	143,500	63,200	127,000	152,600	84,096
	\$632,600	\$631,350	\$631,600	\$633,200	\$633,300	\$630,622

These various principles of allocation of fixed charges have been discussed in some detail by way of illustration of the general problem of finding some fair basis for such an apportionment.

In the transmission and distribution network of the Commonwealth Edison and affiliated companies in and about Chicago, at least seven very large power stations are generating electrical energy. They, with their recently rated generating capacities, are: Fisk-Quarry, 355,000 kw.; Northwest, 165,000 kw.; Crawford Avenue, 423,000 kw.; Waukegan, 120,000 kw.; Calumet, 187,000 kw.; Powerton, 52,000 kw.; and State Line, 208,000 kw. These stations were built at different periods with vastly different unit investments and operating economies. How shall their fixed charges be apportioned in the various rate schedules?

Recent court judgments have declared that, in the large networks involving several cities, the valuation and therefore the fixed charges shall be considered for each consumer city separately and not for the network as a whole which may be supplied from one or more power stations. Again the allocation problem comes to the front as a very important agency in determining values for rate determinations.

Usually a composite of several of the principles enumerated above is used, but in general the method should recognize basic ratios of capital accounts rather than involve operating expenses and load variations, which are too frequently used because of simplicity of calculation, but which have little if any correlation with the fixed charges at issue.

Specific References

1. EISENMAYER, H. E.: "Central Station Rates in Theory and Practice," Fred J. Drake & Company, Chicago.
2. GREENE, W. J.: "Determining Demand Charges," *Elec. World*, Nov. 7, 1925.
3. HILLS, H. W.: "Demand Costs and Their Allocation," *Elec. World*, Jan. 22 and 29, 1927.

General References

EISENMAYER, H. E.: "Straight Lines as Rate Curves," *Elec. World*, vol. 81, June 2, 1923.

MOORE, GEORGE H.: "The Multiple Plant Method for the Equitable Apportionment of Fixed Charges," *J. Am. Inst. Elec. Eng.*, vol. 42, p. 408, Apr. 1923.

Review Questions

Data for Problems 1 to 9 Inclusive: Allocation of fixed (or maximum-demand) charges of an electric light and power corporation.

Valuation = \$100,000,000 at \$500 per kilowatt of rated station capacity.

Ratio of valuation to gross revenue, 5:1.

Operating ratio,* 75 per cent.

Commercial light and power involves 25 per cent of the valuation and 30 per cent of the gross revenue. Of this gross revenue: 30 per cent is chargeable to demand and 70 per cent is chargeable to energy.

Station maximum demand is 90 per cent of the station capacity, and the group maximum demand is 25 per cent of the station maximum demand.

Typical daily load distribution, assuming 300 such typical days per year, for the commercial light and power group has maximum demands of six typical classes of consumers as follows: The group peak occurs between 4:00 and 6:00 P.M.

Class	Maximum demand, per cent of group peak	Hr. on peak	Hr. off peak	Hr., total
A	40	2	..	2
B	25	2	..	12
	10	..	10	
C	20	2	22	24
D	5	..	20	20
E	30	..	2	2
F	15	2	..	12
	35	..	10	

* See Chap. XX, p. 388.

For the commercial light and power group calculate the following:

1. Allocated valuation.
2. a. Allocated gross revenue per year.
 - b. Gross revenue proportional to maximum demand per year.
 - c. Gross revenue proportional to energy output per year.
3. a. Power-station capacity (kilowatts) total.
 - b. Power-station maximum-demand (kilowatts) total.
 - c. Group maximum demand (kilowatts).
 - d. Maximum demands of each *class of consumers* A, B, C, D, E, and F (kilowatts).
 - e. Energy used by each *class of consumers* per day A, B, C, D, E, and F (kilowatt-hours).
 - f. Total kilowatt-hours energy of group per day and per year.
 - g. Load factor* of A, B, C, D, E, F and of entire commercial light and power group.
 - h. Draw to scale rectangular load curve for this group, including all classes.
4. Energy method of allocation of demand charges:
 - a. Gross revenue (chargeable to maximum demand) per kilowatt-hour.
 - b. Gross revenue (chargeable to maximum demand) allocated to each class of consumers A, B, C, D, E, and F on annual basis.
5. Maximum-demand method of allocation of demand charges:
 - a. Sum of maximum demands of all classes.
 - b. Diversity factor* between classes and central-station demand.
 - c. Gross revenue (chargeable to maximum demand) allocated in proportion to maximum demand of each class, A, B, C, D, E, and F (annual basis).
6. Peak-responsibility method of allocation of demand charges. Gross revenue (chargeable to maximum demand) allocated to each class in proportion to maximum demand of each class at time of maximum station demand, A, B, C, D, E, and F (annual basis).
7. Greene method. Same as above, by Greene formula.
8. Phantom method. Same as above, by phantom formula.
9. Summarize in one table the allocation (by all five methods) of the demand charges for all six classes of consumers and compare relative merits of each.
10. A certain utility having annual fixed charges amounting to \$1,200,000 gives service to the groups of customers shown at the top of page 365. Allocate the fixed charges to each group by: (a) the maximum-demand method; (b) the peak-responsibility method.
11. Of an allowed annual gross revenue of \$1,200,000, 40 per cent is chargeable to demand and 60 per cent to energy. The load on this plant is made up of three groups of consumers: A, B, C.

Group A has a maximum demand of 5,000 kw. and a daily load factor* of 50 per cent.

* See Chap. XXVII.

Group	Demand, kw.		Kw.-hr. per year
	On peak	Off peak	
A	5,000	2,000	22,000,000
B	4,000	6,000	10,000,000
C	1,000	1,000	8,760,000

Group B has a maximum demand of 3,000 kw. and a daily load factor of 75 per cent.

Group C has a maximum demand of 2,000 kw. and a daily load factor of 25 per cent.

The maximum demands of Groups A and B accrue at the same time while the consumers of Group C are all off peak.

Assume a 30-day month.

Allocate the fixed charges of the three groups of consumers by: (a) the peak-responsibility method; (b) the phantom-consumer method.

12. A certain utility has four groups of customers with loads according to the following table. Note the peak is 1 hr. in duration and a 30-day month is assumed.

Group	Maximum demand, kw.	Kw. on peak 1 hr. long	Kw.-hr. off peak per day	Kw.-hr. total per 30-day month	Diversity factor* between consumers and group
A	5,000	5,000	12,000	510,000	1.3
B	3,000	3,000	28,800	954,000	1.2
C	2,000	1,000	32,400	1,002,000	1.1
D	1,000	500	21,600	663,000	1.4
	11,000	9,500	94,800	3,129,000	

* See Chap. XXVII.

The part of the gross revenue chargeable to Demand is \$30,000 per month. Allocate on a monthly basis the demand costs to the four groups by (a) maximum-demand method; (b) phantom method.

13. Place a circle around the letter T or F in front of the following statements according to whether you consider each of them to be true or false, respectively:

- T F A class of consumers having 100 per cent load-factor loads pays no portion of the fixed charges in the phantom method of allocation.
- T F The maximum-demand method of allocation of fixed charges takes into account the duration of the demands.

- T F Any method of allocation of fixed charges is subject to more than 5 per cent error.
- T F Energy used by a customer is always proportional to his maximum demand.
- T F A double-peaked load curve with the higher peak in the morning hours is never experienced upon light and power systems.
- T F The greater the diversity factor, the more nearly will the maximum-demand method and peak-responsibility method give the same allocation of demand costs.
- T F None of the methods studied for allocation of demand charges considers in any way the off-peak duration of the customer's load.
- T F The peak-responsibility method of allocating demand charges allocates such charges to off-peak customers in proportion to the ratio of their maximum demand to the maximum demand of the group.
- T F The chief disadvantage of the energy method of allocating demand charges is that it unduly penalizes high load-factor classes.
- T F In allocating demand charges it is necessary to use the same method for all groups in a given company.

CHAPTER XIX

THE BALANCE SHEET

Quite as valuable as the Income account (Chap. XVI) to the executives of the company, and of greater interest to the stockholders, is the balance sheet, which is expected to provide, as of a certain stated date, the exact status of all assets and liabilities of the corporation. In other words it restates, with proper subdivisions, the basic equation: Assets = liabilities + net worth.

This may also be stated as: New assets = liabilities + initial proprietorship + profit (during the past period).

The balance sheet is defined as "a condensed statement of the assets, liabilities, and net worth (or deficiency) of an individual organization, or any financial entity, *at a given date* and in a form more or less definitely prescribed by custom. This statement is universally used to show the financial condition of business concerns."¹

Such a balance sheet, as of the present date and having the same subdivisions or control account summaries, may be compared with the balance sheet of the previous month, quarter, or year and the changes in the two sides of this equation may be studied for better or for worse.

The balance sheet, struck "as of closing of business Dec. 31, 1936," is shown on page 368 for the company whose transactions have been previously set forth in considerable detail (see Chap. XVI). Its creation from the accounts of the control ledger and the possibility of its similarity with the trial balance will be readily noted. The balance sheet, however, should be recognized as a document prepared for outside inspection and favorable comment, while the trial balance is simply a tool to check bookkeeping procedure.

Although the main accounts that are summarized in the balance sheet of various corporations are usually about the same, the extent to which they are subdivided and divulged in detail to the

public may vary widely. Unfortunately it sometimes seems shrewd to some executives to release balance sheets, necessarily with the same totals, but with different amounts of detailed subdivision of accounts, to the public, to stockholders, and to creditors. ✓ Balance sheets should effectively show the same balances and surplus, with the distribution of the net income to

Balance Sheet		
ASSETS		LIABILITIES
Factory	\$ 60,000	Stocks \$150,000
Machines	25,000	Notes Payable 10,000
Cash	110,161	Accounts Payable 2,000
Materials Inventory	2,200	Taxes Accrued 1,100
Goods in Process	2,500	Depreciation Reserve 3,700
Finished Goods	4,200	
Accounts Receivable	5,000	
Insurance	100	
	—————	—————
	\$209,161	\$209,161
	166,800	
	—————	—————
	42,361	
Dividends Declared	20,000	
	—————	—————
Income in Surplus	\$ 22,361	
or with Depreciation applied to Physical Plant Assets		\$163,100
		42,361
	—————	—————
	\$205,461	\$205,461

dividends, depreciation reserve, and increase of surplus as is indicated by the trial balance of similar ledger accounts; but the possible methods of camouflaging a balance sheet to provide too little information, oftentimes actually misleading to the stockholders and the creditors, are legion.

The classification of possible assets into current, fixed tangible, fixed intangible, and miscellaneous assets is best portrayed by the following quotation from Montgomery.²

//1. Current Assets:

- a. Cash (cash "items," if any, must be distributed under some other caption).
- b. Items the equivalent of cash, such as postage, revenue, and war savings stamps.

c. Accounts, notes receivable, and acceptances from trade debtors, net of reserves for bad and doubtful accounts, the maturities of which are less than one year from the date of the balance sheet.

d. Installment or deferred accounts and notes receivable, even though maturing more than one year from the date of the balance sheet, provided that such accounts or notes were accepted in ordinary course and conform to the terms which generally prevail in that line of business.

e. Inventories of raw materials and finished goods, operating supplies, goods in process, and ordinary maintenance material and parts.

f. Accounts and notes receivable from stockholders, employees, and others when separately stated on the balance sheet and known to be collectible within less than one year.

g. Advances on contracts; prepaid expenses, such as interest on bank loans; prepaid royalties, insurance, and taxes; and all other items, such as current advertising, catalogues, and booklets, which directly relate, as does the inventory, to current operations and which, when and as used, are operating costs. This class is limited to those items which would be paid in any event after the date of the balance sheet and which are not indicative of any expansion of the business.

h. Securities and other items which are the equivalent of cash and which are intended to be or which readily may be converted into cash.

2. Fixed Tangible Assets:

a. Plant, including land, mines, other natural resources and development costs, machinery, equipment, automobiles, furniture, tools, containers, and patterns.

b. Inventories of plant items, such as construction and renewal materials and parts other than for maintenance.

c. Items the same as (c) and (f) above, the benefits or maturities of which are more than one year from the date of the balance sheet.

d. Deposits, prepaid items, etc., the benefit of which extend beyond one year from the date of the balance sheet.

e. Securities of subsidiary or affiliated concerns. (If a consolidated balance sheet is not made up, advances to, and accounts receivable from, such concerns should be included in this group.)

f. Fund investments when the assets in the funds are to be applied to the reduction of debts or for reinvestment for the purposes of the concern.

g. Patents when acquired for cash.

3. Fixed Intangible Assets:

a. Patents, trade-marks, copyrights, subscription lists, etc.

b. Good will.

c. Deferred items, such as discount on bonds, and deferred items of an extraordinary nature, such as organization and exploitation expenses.

4. Miscellaneous Assets:

- a. Fiduciary and other items, such as claims and disputed items which cannot be included in the foregoing classifications.
- b. Discount on bonds.

The various subdivisions of liabilities are quoted from the Federal Reserve Board Form of Balance Sheet as follows:¹

Liabilities

Bills, notes, and accounts payable:

Unsecured bills and notes:

- 2. Acceptances made for merchandise or raw materials purchased.
- 4. Notes given for merchandise or raw material purchased.
- 6. Notes given to banks for money borrowed.
- 8. Notes sold through brokers.
- 10. Notes given for machinery, additions to plant, etc.
- 12. Notes due to stockholders, officers, or employees.

Unsecured accounts:

- 14. Accounts payable for purchases (not yet due).
- 16. Accounts payable for purchases (past due).
- 18. Accounts payable to stockholders, officers, or employees.

Secured liabilities:

- 20a. Notes receivable discounted or sold with indorsement or guaranty (contra).
- 20b. Customers' accounts discounted or assigned (contra).
- 20c. Obligations secured by liens on inventories.
- 20d. Obligations secured by securities deposited as collateral.
- 22. Accrued liabilities (interest, taxes, wages, etc.).

Other current liabilities (describe fully):

Total current liabilities.

Fixed liabilities:

- 24. Mortgage on plant (due date _____).
- 26. Mortgage on other real estate (due date _____).
- 28. Chattel mortgage on machinery or equipment (due date _____).
- 30. Bonded debt (due date _____).
- 32. Other fixed liabilities (describe fully):

Total liabilities.

Net worth:

- 34. If a corporation:
 - a. Preferred stock (less stock in treasury).
 - b. Common stock (less stock in treasury).
 - c. Surplus and undivided profits.

Less:

- d. Book value of good will.
- e. Deficit.

36. If an individual or partnership:
- a. Capital.
 - b. Undistributed profits or deficit.
- Total.

It will be noted from these classifications that, while both assets and liabilities include current as contrasted with fixed values, the former have subdivisions of operating and nonoperating properties; the liabilities are also subdivided in such a manner as to be of greatest interest to the equity holders of the enterprise. Such equity holders are either owners or creditors of the concern and the legal distinction between the two becomes the paramount basis for their segregation. The claims of the creditors are usually set forth first among the liabilities, a practice that has been rather generally adopted. This is probably because the owners of the business, who have the residual share of the total property, after all the equity claims of the creditors have been met, will first set up those claims and then state as their own share that which remains.

Another type of subdivision commonly recognized in this section of the balance sheet is that distinguishing the original contributions of capital by the owners from the accretions due to earnings. This is particularly true in the corporate enterprise, where the original capital is normally represented on the balance sheet under the heading of capital stock, while the accumulated and undistributed earnings are set up separately under the heading of surplus or undivided profits. This distinction is a useful one, except that it sometimes blinds people to the fact that the two items must be added together to determine the actual total net worth of the owners.

Still another subdivision of the ownership section of the balance sheet is found when for some reason it is considered desirable to set aside a portion of the accumulated profits for some specific purpose. This is done by the creation of what is properly called a reserve (or a surplus reserve), which is in fact simply a portion of the owner's share in the business, segregated and earmarked for distribution as a dividend. The creation of such a reserve does not necessarily imply that a corresponding amount of property will be set aside out of the assets and invested in some particular way; that may, or may not, be done.

Allowances for depreciation and bad debts are placed in separate accounts for bookkeeping convenience, but constitute in reality mere offsets to and deductions from the assets to which they relate. It may well be borne in mind throughout the consideration of balance-

sheet preparation that the ledger accounts are mechanical devices, while the balance sheet is an analytical statement, and that the classification of items in the balance sheet may not be identical with that in the ledger.³

In the case of public utilities, the accounting system to be used is outlined in considerable detail by the public service commission of the state or the Federal Interstate Commerce Commission or Federal Communications Commission for interstate service, and such accounting systems are necessarily summarized in the required annual reports into balance sheets having sufficient detail to warrant careful and accurate comparison between corporations as well as between different periods of time for the one corporation.

The balance sheet on pages 373 and 374 of a large electric light and power utility, having comparisons of beginning and ending values for the period being investigated in many subdivided accounts, is a good example of the possibilities for study on the part of executives, stockholders, and creditors with regard to the development of the business during the period in question.

One important study that may be made of such a balance sheet is to compare the so-called "current assets" with the "current liabilities." A proper interpretation of such current assets and current liabilities can be made only after a careful analysis has been undertaken of all the accounts by one who is familiar with the credit status and policies as well as the accounting system of the particular company in question. An auditor, in this particular case, defined those items underlined in the "Balance at close of period" columns as current assets and liabilities, respectively. The ratio of nearly 2.5 to 1 of current assets to current liabilities discloses an unusually strong financial status for this company, since this indicates that in case of sudden financial emergency it could, within the period, raise 2.5 times its immediate obligations in the form of cash.

Balance Sheets of Affiliated and Consolidated Companies.—In Chap. VII on Reorganization, Consolidation, and Merger of corporations, the process of taking over subsidiary companies by the parent company was explained and some of the resulting balance sheets were outlined. The variations in such balance sheets, with the frequent "balancing off" of subsidiary items

thereof, to form consolidated balance sheets of the composite or holding companies, are best described by Greer as follows:

A familiar factor in the modern industrial situation is the large-scale enterprise operated not as a single corporation, but as several companies

Comparative Public Utility Balance Sheet
ASSETS

Items	Balance at close of period	Balance at beginning of period	Increases	Decreases
Plant Investment:				
Finished.....	\$10,542,100	\$10,226,400	\$315,700	
Work in Progress.....	113,700	103,900	9,800	
Current Assets:				
Cash.....	240,900	239,100	1,800	
Bills Receivable.....	3,800	4,000	.....	200
Accounts Receivable.....	293,100	271,700	21,400	
Interest and Dividends Receivable.....	11,800	10,800	1,000	
Business Assets:				
Material and Supplies...	267,300	246,700	20,600	
Prepayments.....	900	950	.....	50
Nominal Assets:				
Special Deposits Coupon Interest.....	82,500	81,775	725	
Investments:				
Bound.....	138,000	138,000	.....
Free.....	1,036,700	952,100	84,600	
Treasury Securities:				
Bonds.....	None	29,000	.....	29,000
General.....				
Casualties.....	5,000	6,500	.....	1,500
Supplies Expense.....				
Accounts Receivable.....				
Miscellaneous Billing.....	16,900	14,100	2,800	
Debt, discount, and expense.....				
Totals.....	\$12,752,700	\$12,325,025	\$458,425	\$30,750
Current assets (underlined)	545,800			

Comparative Public Utility Balance Sheet
LIABILITIES

Items	Balance at close of period	Balance at beginning of period	Increases	Decreases
Funded Debt:				
First Mortgage.....	\$ 3,300,000	\$ 3,300,000		
Debenture Bonds.....				
Real Estate Mortgages..	57,000	54,000	3,000	
Current Liabilities:				
Notes Payable.....	1,300,000	1,180,000	120,000	
Accounts Payable.....	140,600	129,300	11,300	
Coupon Interest Matured	82,500	81,775	725	
Dividends Declared.....	64,500	63,000	1,500	
Customers' Deposits....	38,000	35,000	3,000	
Service Extension.....	400	450	.....	50
Accrued Liabilities:				
Unmatured Coupon Interest.....				
Unmatured Real Estate Mortgage Interest....	712	675	37	
Unmatured Loan Interest.....	26,000	23,600	2,400	
Taxes Accrued.....	25,000	20,000	5,000	
Rents Accrued.....	9,700	9,700		
Wages Accrued.....	2,700	2,500	200	
Miscellaneous Expenses Accrued.....	1,300	1,350	.....	50
Corporate Reserves:				
Premium on Stock.....				
Premium on Debt.....	17,400	15,900	1,500	
Operating Reserves:				
Renewal and Contingency.....	1,165,700	1,065,800	99,900	
Service Annuities.....	68,000	63,300	4,700	
Capital Stock:				
Debenture.....				
Preferred.....				
Common.....	4,300,000	4,200,000	100,000	
Profit and Loss.....	2,153,188	2,078,675	74,513	
Totals.....	\$12,752,700	\$12,325,025	\$427,775	\$100
Current liabilities (underlined).....	218,800			

under common ownership, or with one company owning controlling interests in the others. Such companies are said to be "affiliated"; when one concern owns most or all of the stock in other corporations, it is called a "holding" company, with the others as "subsidiaries." The holding company may be an operating company and control other operating companies, or it may be merely a nonoperating corporation formed for conveniently concentrating the ownership of several operating companies.

In any event, it is apparent that one of the principal assets of the holding company—if not the only one of considerable size—will be its investment in affiliated or subsidiary companies. This may take several forms; there may be capital stock owned, bonds owned, loans on unsecured notes, sales and cash advances on open account, and so on. Properly these items should be placed among the nonoperating assets of the owning company, as they represent capital invested in outside enterprises. If this is done, however, there may be so large a proportion of assets in the nonoperating group as to throw the statement out of normal balance. When nonoperating assets begin to show as larger and more numerous than operating assets, it is evident that the statement is in error as to what constitutes the major field of operations.

Such a situation, moreover, may cast doubt on the actual financial position of the owning company. The condition of its own finances may be satisfactory, but the subsidiaries in which a large part of its capital is invested may be seriously involved. The status of advances to these subsidiaries on short-time loans, for example, is always in question until examination has been made of the ability of the subsidiaries to pay. The value of stock of subsidiaries owned is, of course, equally doubtful.

To clarify such situations it is common accounting practice to combine, or "consolidate," the statements of such affiliated companies into one composite balance sheet, representing the condition of the whole group of undertakings viewed as one enterprise. All assets of similar character are added together, and all liabilities to outsiders are likewise totaled. The advances and investments between the companies are balanced off against one another, so that the final consolidated statement represents only relationships of the group of enterprises with its properties, its creditors, and its owners. No "nonoperating" assets will be left in the statement, except as there may be minor outside investments not concerned in the consolidation.

A number of exceedingly complex problems are met when such a combination of balance sheets is to be effected, and the accountant's skill is often heavily taxed to cope with all the difficulties which arise. The basic principle is, of course, reasonably simple—that an investment of one company in another represents tangible assets and specific liabili-

ties and that those assets and liabilities can be carried into the holding company's statement in lieu of the "stock investment" account which takes their place on the books. Insofar as the subsidiary companies are owned 100 per cent by the holding company, their capital stock will disappear from the statements altogether when a consolidation is made—being eliminated as an asset of the holding company and as an equity or ownership item of the subsidiary. Similarly, loans of one company to the other, carried as an asset by the first and a liability by the second,

The White Company and Subsidiary Consolidated Balance Sheet at Dec. 31, 1926

	White Com- pany	Black Com- pany	Elimina- tions	Consoli- dated
ASSETS:				
Current:				
Cash.....	\$ 8,000	\$ 1,000	.....	\$ 9,000
Receivables.....	12,000	9,000	.....	21,000
Merchandise.....	27,000	12,000	.....	39,000
Fixed:	*			
Machinery and Equipment.....	33,000	69,000	.....	102,000
Buildings.....	51,000	43,000	.....	94,000
Land.....	5,000	10,000	.....	15,000
Interest in Subsidiary:				
Advances to Black Company.....	10,000	.....	\$ 10,000(a)	
Capital Stock in Black Com- pany.....	100,000	.....	100,000(b)	
Total.....	\$246,000	\$144,000	\$110,000	\$280,000
LIABILITIES AND NET WORTH:				
Current Liabilities:				
Payables.....	\$ 18,000	\$ 11,000	.....	\$ 29,000
Loans.....	5,000	15,000	.....	20,000
Advances from White Com- pany.....	.....	10,000	\$ 10,000(a)	
Net Worth:				
Capital Stock.....	200,000	100,000	100,000(b)	200,000
Surplus.....	20,000	8,000	.....	31,000
Total.....	\$246,000	\$144,000	\$110,000	\$280,000

are canceled against each other when a consolidated statement is prepared.

A simple case is illustrated in the balance sheet shown on page 376 of the White Company, which is given in condensed form in the first column. It shows, among other things, that the White Company owns all the stock of the Black Company, whose balance sheet is given in the second column; also that the White Company has loaned the Black Company \$10,000, which appears as a liability in the Black Company statement. A consolidation of the statements is made by adding together all similar items and eliminating the intercompany accounts (shown for memorandum purposes in the third column). The Black Company capital stock disappears from the statement; it represents no ownership by *outsiders*, so far as the combined enterprise is concerned. In the consolidated statement the White Company's investment in the Black Company appears in the form of the actual cash, inventories, plant, and other assets utilized in operations instead of as a nonoperating investment in the capital stock of an unrelated concern.

Complications arise when the ownership by one company of another is not complete but partial, and possibly changing in extent; when the cost of the investment to the holding company differs from the book values on the subsidiaries' records; when the make-up of the consolidated Surplus account comes into question; and at other times. Such problems are outside the scope of this volume. It is intended here merely to indicate the fundamental circumstances met and the general method followed in dealing with them.³

Thus it may be seen that the preparation of a so-called consolidated balance sheet involves exactly the same principles as have been outlined herein for any other type of balance sheet except that the assets and liabilities, and particularly the stocks and bonds listed, are, at least partially, those of subsidiary companies. The assets and liabilities of the constituent companies are, therefore, included with those of the controlling company, after eliminating therefrom the intercompany stocks, bonds, and accounts which indicate the relation of one company to another.

A few of the special features peculiar to consolidated balance sheets are listed by Bennett as follows:⁴

1. Intercompany obligations—existing debts among the constituent companies for goods sold, for advances made to one another, and for bond interest accrued, or declared dividends—being offsetting assets and liabilities, are usually eliminated from the combined statement,

though they are sometimes included, either separately or with other current items.

2. Guarantees, leases, and other contracts existing between the parent company and subsidiaries are shown in the balance sheet among the assets and liabilities or as footnotes.

3. The extent of ownership in the subsidiary companies' stock—whether the parent company owns all, a controlling interest, or only a portion thereof—and the extent of ownership by the underlying companies in the stock of the parent company or of the other companies, should be clearly stated, either in the balance sheet or in a supporting schedule. The minority interest in surplus profits is sometimes indicated also.

4. The parent company's ownership of bonds of the subsidiary companies, and vice versa, should also be shown.

Specific References

1. MONTGOMERY, R. H.: "Financial Handbook," Ronald Press Company, New York.
2. MONTGOMERY, R. H.: "Auditing Theory and Practice," Ronald Press Company, New York.
3. GREER, HOWARD C.: "How to Understand Accounting," Ronald Press Company, New York.
4. BENNETT, R. J.: "Corporation Accounting," Ronald Press Company, New York.

General Reference

- SALIERS, E. A.: "Accountant's Handbook," Ronald Press Company, New York.

Review Questions

1. Distinguish between a trial balance, an income account, and a balance sheet.

2. a. List the more important items that you would expect to find upon the balance sheet of a public utility company and indicate whether each is an "asset" or a "liability."

b. Indicate a good test of a balance sheet to determine the ability of the company to withstand temporary depressions.

3. Out of the following account balances of Company A, list, on the proper side, those which should appear upon a balance sheet: physical plant, prepaid insurance, accrued taxes, Company A stock outstanding, surplus, accounts receivable, Company B stock owned by Company A, and dividends declared.

4. The following items appear on the balance sheet of a public utility company. Indicate with an *A* or an *L* whether they are assets or liabilities, respectively: bonds of another company owned by this company; bonds of

this company outstanding; accounts payable; customers' meter deposits; depreciation reserve; rent accrued on office space leased to another company; taxes accrued on this company's property; extra poles on hand; capital stock discount and expense; stocks of another company owned.

5. List the following items upon the proper side of a balance sheet and determine the profit and loss item necessary to provide a balance:

Cash on Hand.....	\$ 55,000
Outstanding Bonds.....	100,000
Capital Stock.....	200,000
Accounts Receivable.....	25,500
Inventory.....	32,000
Patent Rights Owned by Company.....	75,000
Accounts Payable.....	20,000
Dividends Declared.....	5,000
Real Estate Owned.....	200,000

6. List the following summary accounts in the left or right column as you consider them as assets or liabilities, respectively: inventory of material, meter deposits paid by customers, notes receivable, dividends declared, treasury stock, cash on hand, profit undistributed, depreciation reserve, wages accrued, and real estate.

7. List the following items as assets or liabilities of Company A and determine the amount required to balance the balance sheet of Company A. Is it an asset or a liability? Why?

Plant and Property.....	\$59,000,000
Capital Stock.....	32,000,000
Funded Debt.....	27,000,000
Investments in Other Companies.....	1,100,000
Prepayments of Rents, etc. by Company A.....	2,233,000
Notes Payable by Company A.....	400,000
Taxes Accrued.....	500,000
Accounts Receivable by Company A.....	700,000
Cash.....	1,375,000
Depreciation Retirement Reserves.....	2,000,000

8. Given the following balance sheet, would you consider this company in good or bad financial condition as of the date of the above statement and why?

ASSETS

Plant Investment.....	\$8,000,000
Cash on Hand.....	250,000
Accounts Receivable.....	300,000
Interest and Dividends Receivable.....	12,000
Materials and Supplies.....	250,000
Investments.....	1,000,000
	<hr/>
	\$9,812,000

	LIABILITIES
First-mortgage Bonds.....	\$4,000,000
Accounts Payable.....	140,000
Dividends Declared.....	64,000
Customer Deposits.....	38,000
Rents Accrued.....	10,000
Wages Accrued.....	3,000
Common Stock.....	4,000,000
Profit.....	1,557,000
	\$9,812,000

9. Do you consider the company whose balance sheet is given below in good or poor financial condition and why?

	ASSETS
Plant, Property, Rights, Franchises, etc.....	\$ 82,554,751.54
Capital Stock Discount and Expense.....	1,568,356.98
Investment in and Advances to Affiliated Companies	4,373,588.55
Special Deposits.....	16,053.71
Debt Discount in Process of Amortization.....	5,012,209.39
Other assets.....	3,417,456.18
Current assets.....	3,096,774.26
Total assets.....	\$100,039,190.61

	LIABILITIES
Funded Debt.....	\$ 50,902,500.00
Preferred Stock.....	22,008,000.00
Common Stock.....	20,968,700.00
Deferred Liabilities.....	984,197.55
Current Liabilities.....	3,453,482.83
Reserves for Depreciation.....	1,810,825.77
Surplus.....	411,484.46
Total liabilities.....	\$100,039,190.61

10. Prepare the Income account for the light and power company having had the following business during the year and determine the net profit if its property is valued at \$500,000, its depreciation rate 5 per cent, insurance and taxes 3 per cent, and its bond interest on a bond issue of \$200,000 is 6 per cent.

Received from sale of electrical energy.....	\$125,000
Power plant operating expenses.....	30,000
Distribution and billing expenses.....	50,000
Overhead office expenses.....	5,500

- 11.** Prepare an income statement for this public utility showing the net income and the surplus:

Operating revenue.....	\$13,000,000
Operating expense (including depreciation).....	7,000,000
Taxes.....	1,400,000
Interest on unfunded debt.....	100,000
Interest on funded debt.....	1,500,000
Dividends declared: 7% preferred.....	524,000
6% preferred.....	399,000
5½% preferred.....	25,000
Common.....	2,055,000

- 12.** A manufacturing corporation begins business with a cash capital of \$100,000 made up of common stock sold at par. It purchases and equips a factory for \$30,000 and raw materials for \$12,000; light, heat, and power cost \$3,800 per annum; the factory pay roll is \$22,500; additional maintenance is \$1,000; and fixed charges are 12 per cent on factory cost for the year. If half the raw materials purchased are fabricated into finished product and sold at \$75,000, and if one-third of the net income is paid in stock dividends, one-sixth placed in a depreciation fund, and the remainder in surplus:

- a. Show the income account for the year.
- b. Show the balance sheet for the year.

CHAPTER XX

GROSS REVENUE

Now that the methods of preparing the various important accounts of a business have been outlined, an analysis of such accounts and their effects upon the owners (stockholders) and creditors (bondholders) of the corporation is in order.

The *gross revenue* represents the total amount of money taken in, from all sources, by the corporation during any one year. It usually comprises the monetary return from the sale of commodities and/or services and the dividends or interest upon any stocks or bonds held by such a corporation. The relation of such gross revenue for any one year to the capitalization, or to the investment with which the business is carried on, is an important factor in the analysis of the relative success of such a business throughout comparative years of progress.

Furthermore, the disposition of this gross revenue among the various requirements of expenditure, profit, and surplus is one of the most important problems of the business executive. Before proceeding with a more detailed analysis of typical cases of distribution of gross revenue, it should be noted that, whereas the sales price, volume of sales, and resultant gross revenue of a competitive manufacturing or merchandising business are usually based upon "what the traffic will bear," in the face of whatever competition may exist in a particular industrial field, the reverse process is necessarily adopted in the determination of the gross revenue of the public utility company. In this line of business, where no competition exists and where a monopolized necessity is being furnished to the public, it will be noted in Chap. XXVI that the net income allowable is established by the state commission. Although this net income, usually expressed as a percentage of the valuation, capital, or rate base, as the case may be, may vary from 4.5 to 10 per cent in different cases adjudicated by various commissions, the average is approximately 7.5 per cent.

Assuming this percentage of a predetermined valuation to have been determined by the commission, thus representing a definite "fair return," expressed in dollars per annum, the following additions are usually allowed by the commission to establish gross revenue, if they are not found to be excessive in any case. Annual gross revenue therefore comprises: fair return (usually about 7 per cent of valuation) + annual operating expenses + annual fixed charges. Annual fixed charges, in turn, usually include: taxes, insurance, and annual payments to a depreciation fund. In some cases taxes are included among operating expenses. Interest on borrowed capital, dividends, and surplus must come from the fixed (7 per cent) fair return.

Possibly the analysis of one or more concrete cases will best illustrate the structure of gross revenue. Although these illustrations are taken from the returns of several years ago, they are considered more appropriate for the purpose than the temporarily readjusted figures which have necessarily existed in all lines of business during the last few years of the depression.

The American Telephone and Telegraph Company¹ received from all sources, as the result of its activities during the year 1931, approximately \$1,076 millions. Such revenue is made up of several major subdivisions such as: (1) telephone operating revenues; (2) miscellaneous revenues; (3) dividends on securities held; and (4) interest.

The disposition of the average monthly gross revenue per telephone in the Bell System during the year 1931 was as follows:

Revenue.....	\$ 5.99
Expenses.....	\$4.11
Taxes.....	0.49

	4.60
Net earnings.....	\$ 1.39
Interest.....	\$0.35
Dividends.....	0.97

	\$1.32
Balance for contingencies and surplus.....	\$ 0.07

Since the operating ratio* for the year may be considered, in round numbers, to be proportional to that based upon the above

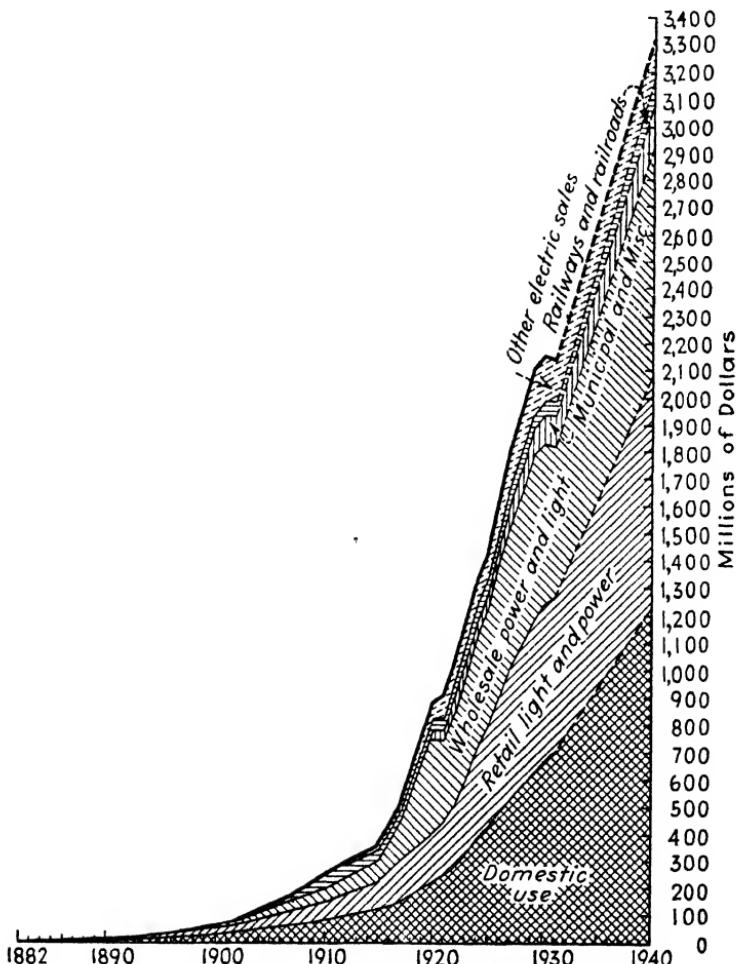


FIG. 31.—Gross revenue of electric light and power companies of the United States.

unit values per telephone per month, such a ratio would be $\$4.11/5.99 = 68.6$ per cent, without including taxes in operating expense, or $\$4.60/5.99 = 76.9$ per cent if taxes are considered as

* "Operating ratio" is defined as the ratio of operating expense (either with or without taxes) to gross revenue (see Chap. XX).

a part of the operating expense. These values will indicate the importance of the analysis of the operating ratios of various companies, and particularly the necessity of stating, in each case, whether or not taxes are included as a part of the numerator of such a ratio whenever comparisons are to be made.

Similarly, if we analyze the electric power and lighting utility for the entire United States for the year 1931, we find a gross revenue of \$2,127 millions, with an operating expense of \$920 millions, representing an operating ratio (without taxes, interest,

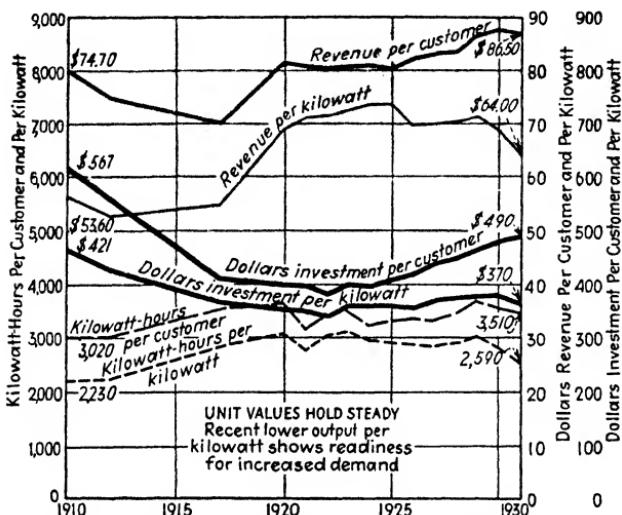


FIG. 32.—Revenue, output, and investment per customer and per kilowatt.

depreciation, or amortization) of $\$920/\$2,127$ millions = 43.3 per cent. With the additional tax expenditure of \$200 millions this ratio becomes $\$1,120/\$2,127$ millions = 52.6 per cent.

Incidentally, as an argument in favor of the relative stability of the electric light and power business as compared with the more fluctuating industrials, it should be noted that this gross revenue of the electric central-station business increased during the depression year 1930 by 2.5 per cent over the previous maximum year 1929 and decreased only 0.7 per cent in 1931 as compared with the year 1930.

The increases in gross revenue of this public utility business during recent years, as well as the variations in the sources of such revenues and their probable trend to 1940, are well depicted

in the accompanying graphs (Figs. 31 and 32) taken from *Electrical World*.² Also the accompanying Table XXXIII illustrates not only the interesting variations in operating and maintenance expenditures from gross revenue in the different sections of the country, but also emphasizes again the necessity of an exact definition of the factors entering into the operating ratio. If, for example, the years 1917, 1922, and 1927, common to both tables, are compared, it will be found that the portion of the operating

TABLE XXXIII.—OPERATING AND MAINTENANCE EXPENSES OF CENTRAL STATIONS
(Millions of Dollars)

Including taxes, interest on funded and floating debt, depreciation, and sinking fund

Year	United States	New England	Atlantic	North Central	South Central	Mountain Pacific
1907	134.2	12.6	49.7	39.8	9.5	22.6
1912	234.6	21.4	84.1	76.4	15.0	37.7
1917	426.6	42.0	153.4	144.6	27.6	59.0
1922	859.6	83.0	309.0	296.4	58.8	112.4
1927	1,318.3					

Exclusive of taxes, interest on debt, depreciation, and sinking fund

1917	284.8	29.7	107.8	99.6	17.6	30.1
1922	553.0	57.7	202.7	197.0	39.1	56.5
1927	828.2	71.2	308.2	282.9	85.8	80.1
1928	866.3	75.6	327.3	280.8	91.4	91.2
1929	934.9	79.7	340.4	315.6	102.9	96.3
1930	942.2	79.6	350.4	311.8	105.4	99.0
1931	920.3	77.4	348.2	297.0	97.5	100.2

expenses chargeable to taxes, interest on funded and floating debt, depreciation, and sinking fund has increased the otherwise more nearly normal operating expenses by 50 per cent in 1917, 55.5 per cent in 1922, and 59.4 per cent in the year 1927. Operating ratios, within which one or more of such items may or may not have been included, are therefore frequently compared to the unwarranted disadvantage of some of the utilities involved.

When it is noted that the investment of the American Telephone and Telegraph Company is approximately \$4 billions and the light and power utilities of the country \$12.4 billions, the

reader who may be more familiar with merchandizing and manufacturing industries is forcefully impressed with the relatively low ratio of gross revenue to investment among the utilities, i.e., $\$1.1/\4 billions = 27.5 per cent in the former, and $\$2.127/\12.4 billions = 17.1 per cent in the latter case. In other words, the capital or property value, and therefore the capitalization (approximately), necessary to carry on a public utility business are very much greater in proportion to the gross revenue than is the case with a manufacturing establishment or department store. In the language of the merchant, he may "turn over his capital" from two to four times a year, meaning that he buys goods, places them upon his shelves where they become capital, sells them, and uses the revenue therefrom to buy more goods, etc., all of which may be repeated several times a year. Contrast that condition, if you will, with the light and power company, with its tremendous investment in generating stations, transmission lines, substations, distribution systems, etc., standing "ready to serve" the consumer, *as he may demand*, but never used to full capacity. The electrical generating stations and permanent distribution systems of the United States alone are valued at approximately the twelve billions previously quoted, while the telephone companies have over four billions of dollars, fifteen million telephones, and seventy-nine million miles of wire, not to mention real estate and auxiliary equipment, ready to connect your home or your store with any one of 123 million other people available in this country alone. *Such capital cannot be readily or frequently "turned over."* In fact, if we divide the capitalization by the annual gross revenue for the year 1931, we find figures of "annual turnover" of 3.64 years for the telephone utilities and 5.82 years for the average of the electric light and power companies of the country. Many other public utility companies have much higher ratios than those indicated. A moment's reflection will demonstrate the fact that the average hydroelectric system, with its expensive riparian rights, storage reservoirs, dams, and power stations, must necessarily require a very high ratio of capital to gross revenue. Fortunately, the operating expenses of such a system are relatively low, so that it is usually possible to maintain a relatively low "operating ratio" and thereby compare favorably with steam-generating stations.

However such ratios may vary, the significant fundamental fact in the study of public utility finance is: *the ratio of capital or capitalization to gross revenue is necessarily high.*

Subsequently, frequent reference will be made to the valuable financial data available in such publications as Moody's and Poor's Public Utilities and Industrials. From the former the following important definitions of ratios relating to gross revenue are quoted. Although many of these involve net income and dividends as well as gross revenue, and therefore become available for further reference values in subsequent chapters (see Chap. XXI, Tables XLII to XLV inclusive), they may be appropriately defined at this point as follows:

Operating Ratio.—This figure shown as a percentage in earnings statements throughout the manual indicates the relation of operating expenses, maintenance, taxes, and depreciation (where reported) as a total to gross operating revenues. The resulting operating ratio affords a measure for determining the efficiency with which the enterprise is conducted and, while its value is greater in comparing the year-to-year trend, it has a limited use in comparing very similar enterprises.

Times Charges Earned.—“Times Charges Earned” is shown in the income accounts of operating companies and holding companies (parent-company statements only) where the company has bonds or notes outstanding. This ratio indicates the relation between earnings (after depreciation or retirement expense) available for payment of all interest charges, debt discount and expense, rentals (when separately shown), and other income deductions on the one hand and the aggregate amount of all these charges on the other hand.

Times Charges and Preferred Dividends Earned or Over-all Coverage Preferred Stock.—This ratio is shown in the income accounts of operating companies and holding companies (parent-company statements only) where the company has preferred shares outstanding.

It is computed in a manner similar to that used with respect to “Times Charges Earned,” the comparison being between earnings as there defined on the one hand and preferred dividends plus fixed charges, the latter also as there defined, on the other.

Times Bond Interest Earned.—“Times Bond Interest Earned” as shown in the bond-record tables shows the number of times current interest requirements have been earned on individual issues based on average available earnings over a period of years. Furthermore, “Times Interest Earned” as applied to junior bonds and notes in the bond tables is cumulative. That is, interest requirements on the junior

issue or issues, plus interest on underlying bonds, are divided into average income after depreciation (except in designated cases where not reported) available for all interest.

The cumulative method is designed to eliminate discrepancies due to the varying amounts of several issues and diminishes progressively with each successive issue. It is based on the fact that the interest requirements of all prior obligations have to be met before "Times Interest Earned" can be calculated for a given issue. A much fairer conclusion is reached by applying this total interest charge to the average income available than by indicating a new balance available after each interest deduction. This figure will usually give an accurate key to the position of the bond issue so far as income results and earning power are concerned.

Times Over-all Charges Earned.—This calculation is made only on consolidated statements of holding companies and may be defined as the number of times that fixed charges and subsidiary preferred dividends (in the aggregate) were covered by total available earnings after depreciation, excluding in certain cases profit on the sale of securities. In order to render the ratios as nearly comparable as possible, it has been necessary to rearrange many statements and to combine required surplus charges. Amortization of debt discount, etc., and rentals (wherever available) have been included in fixed charges; interest has been shown as a net figure after credits for construction, etc., and, where possible, minority interest has been deducted before arriving at the available balance. All special cases have been explained by footnotes.

"Over-all" ratios are in all cases preferable to so-called "times after" ratios, which are computed by applying the balance after all prior deductions to each layer of charges or dividends. Nevertheless, the "over-all" ratios are not an exclusive criterion and must be judged in the light of the individual company's sources of income, operating ratio, character of territory, franchise and governmental regulation situation, maintenance and depreciation policy, credits for interest during construction, capital structure, current position, ability to transfer funds from foreign countries, rate of exchange used as a basis in compiling statements, and other pertinent factors.

Times Over-all Charges and Preferred Dividends Earned or Over-all Coverage Preferred Stock.—This calculation is similar to that described above, the comparison being made between available earnings on the one hand and the sum of fixed charges and subsidiary and parent-company preferred dividends on the other hand.

Earned Per Share.—This figure is based on the amount of preferred or common stock outstanding at the close of each year after deducting

all prior charges and dividends paid or accrued for the year. Some exceptions have been made where outstanding stock has been largely increased late in the year, in which instances earnings per share are based on the average amount of stock outstanding during the year.

"Earned on stocks" is shown in dollars per share, except in the case of foreign companies, where it is shown on a percentage basis.

Per Cent of Balance for Common to Gross Revenues.—This figure represents the ratio between the balance of earnings available for the common stock, on the one hand, to gross revenues, on the other hand. It is thus a general index of the earnings equity of the stock, a large percentage indicating a limited susceptibility to earnings fluctuations and, therefore, investment character, while a small percentage is typical of a speculative stock subject to wide earnings fluctuations. However, this ratio, like all those based upon revenues, is subject to the relative level of rates which affects the amount of revenue produced by a given property.

Per Cent Depreciation to Gross Revenues.—Over a period of years this is a rough measure of the adequacy of depreciation or retirement appropriations, which bear a relation both to the utilization of the property (indicated by gross revenues) and to the value of the property, in turn related to gross revenues as indicated by the "Ratio of Depreciated Fixed Assets to Gross Revenue," defined below. Since it is often debatable whether certain property should be replaced from current maintenance or from the retirement (depreciation) reserve, the "Per Cent Depreciation to Gross Revenues" should be considered in conjunction with the "Per Cent Maintenance to Gross Revenues." These ratios must be used with caution and one must particularly avoid comparing those for companies whose properties are dissimilar, i.e., electric companies with steam-generating plants, those with hydroelectric plants (which depreciate slowly), companies producing and distributing manufactured gas, those buying and distributing natural or mixed gas, telephone companies, telegraph companies, water companies and transportation companies. See also comment on level of rates under "Per Cent of Balance for Common to Gross Revenues."

Per Cent Maintenance to Gross Revenues.—Over a period of years this is also a rough index to be used both in conjunction with the "Per Cent Depreciation to Gross Revenues" in judging the adequacy of expenditures and appropriations for the preservation of the properties and independently to a limited extent in judging the condition of the properties. See also comment on level of rates under "Per Cent of Balance for Common to Gross Revenues."

Per Cent Depreciation to Depreciated Fixed Assets.—This is also an index of the adequacy of depreciation or retirement appropriations.

Theoretically it is more accurate than the "Per Cent Depreciation to Gross Revenues," but it is often unreliable because the book value of different properties is determined by widely different principles. The note of caution to avoid comparisons between dissimilar properties cited above under "Per Cent Depreciation to Gross Revenues" is likewise applicable to this figure. See also comment on level of rates under "Per Cent of Balance for Common to Gross Revenues."

Ratio Depreciated Fixed Assets to Gross Revenue.—This is a rough measure of the reasonableness of the book value of a property and may be used in conjunction with the "Per Cent Depreciation to Depreciated Fixed Assets" to make allowances for the divergent principles of determining property values. The note of caution to avoid comparisons between dissimilar properties cited under "Per Cent Depreciation to Gross Revenues" is likewise applicable to this ratio and one should also see the comment on level of rates under "Per Cent of Balance for Common to Gross Revenues."

Average Income.—In the bond and stock tables will be found a column headed "Average Income." The figures given in this column are based in all cases on the income results shown in the income statements of the company under consideration. Where possible, a five-year income statement has been furnished and the average income available would be the annual average income after depreciation (except in designated cases where not reported) available for charges for the five-year period. This figure is used as a basis which influences the ratings given.

It will be noticed that in many cases where a company has two or more bond issues the "average income" has been jointly applied to the issues. This method has been adopted for the reason that in a considerable number of cases a company may have several issues outstanding, all secured by a first mortgage on different parts of its properties, but none of these issues may have a prior claim on total earnings over one another. In these cases it has been absolutely necessary to treat the bonds as having a "joint claim" on this aggregate income. Of course, it will be agreed that many of these bonds have wide difference in actual security, but, if they are obligations of a company and this company operates the properties on which these different bond issues are secured as a whole, then no figures at all can be shown as applying to these issues except in this way.

Where the bond issues of a company, however, are in distinct positions, as, for example, a first, second, third, or fourth mortgage on the same properties, it has been a much simpler matter to show the "average income" for the different liens. In such cases the first-mortgage bond is naturally given the first claim on the income; the second-mortgage

bond the first claim on the balance of income after the first-mortgage issue has been provided for; the third-mortgage bond the first claim on the remainder of income after the first- and second-mortgage bonds have been provided for, etc.

The average income available for the stock issues is an annual average, usually of the surplus figures for the period of years reported after all prior charges, and depreciation (except in designated cases when not reported), have been provided for. In some instances, where rapid expansion has taken place in a property or new subsidiaries have been acquired very recently, the income available given for the stocks is that of the latest year or two rather than the full five-year period.

Per Cent Net Earnings to Depreciated Fixed Assets.—This figure indicates the realized rate of return on the book value of the properties without allowance for working capital and other elements such as going concern value not included in the property account. For these reasons and especially because the book value of different properties is determined by widely different principles, this ratio is of an approximate nature. However, it is useful in year-to-year comparisons for the same company and also between companies when allowances are made for the factors mentioned in the previous sentence. The "Ratio Depreciated Fixed Assets to Gross Revenues" is often helpful in this connection.

Per Cent Funded Debt to Depreciated Fixed Assets.—This computation reflects the extent to which the properties have been bonded, a low percentage indicating a conservative policy and, consequently, a strong bond, while a high percentage indicates the converse. These conclusions, however, are subject to the reasonableness of the book value of the properties (see "Ratio Depreciated Fixed Assets to Gross Revenues") and to exceptions in the case of industries unable to earn a fair return on the value of their properties as determined by cost or physical appraisal. The transportation industry is the outstanding example of such a case and this ratio is, thus, of only minor value in judging transportation bonds. Furthermore, these ratios are not comparable among companies in different industries, some of which (a hydroelectric plant for instance) may conservatively be bonded to a greater extent than others, viz., natural-gas companies.

Per Cent of Total Capitalization.—These figures show how the capital structure is proportioned, a large equity in preferred, common stock, and surplus typifying a conservative structure with relatively small fixed charges and a large equity in common stock and surplus, conservative preferred and common-stock issues. These conclusions, however, are subject to all the reservations made under "Per Cent Funded Debt to Depreciated Fixed Assets."

The effect of varying ratios of capitalization to gross revenue from 2 to 1 to 6 to 1 and the possible variations in operating ratios are particularly well demonstrated in Table XXXIV and the following discussion by Nathan H. Daniels, Jr.:³

Every business enterprise is conducted primarily for profit. The value of an undertaking is judged both by the size and stability of the return which is made on the present investment and by the possibility of enlarging the business under conditions such that it will yield a return sufficient to attract additional capital. A reduction in the cost of operation will evidently increase the return and, if the property is maintained in good condition, this will usually increase the value of the business. The factors which determine the desirability of making further investment to increase the gross earnings, while of equal importance, are not so apparent, and are often overlooked in planning for the future.

The amount which can profitably be invested in any undertaking is often expressed as a multiple of the annual earnings, the factor varying, of course, for different lines of business. It is not generally appreciated, however, that this factor also varies with the ratio of expenses to earnings, and that a company with a low operating ratio can profitably make a much larger increase in investment to secure a given growth in earnings than can one where the cost of operation is higher. Consequently, companies having a low ratio are often unnecessarily conservative in extending their business, while others operating at a higher ratio increase their investment more rapidly than the resultant earnings justify, and then wonder why there is no increase in return in spite of a large increase in gross earnings.

This principle is general and will apply to any line of business, but it is of greatest assistance in planning the development of those lines of activity where frequent extensions are required and which call for a large permanent investment. This is the case with public service corporations; hence a street-railway company has been taken to illustrate this article. The limiting effect of the operating ratio on the rate of expansion is clearly shown if we consider a business having gross earnings of \$100 per year. Assume that the investment can be expressed as a multiple of the annual earnings, and that the business is of such character that an amount equal to $1\frac{1}{2}$ per cent of the investment must be paid each year for taxes and $2\frac{1}{2}$ per cent set aside to provide for sinking fund, depreciation, and obsolescence, which last, at compound interest, corresponds to an average life of the property of from twenty to twenty-five years.

TABLE XXXIV.—EFFECT OF VARIATIONS IN THE RATIO OF INVESTMENT AND OF EXPENSES TO GROSS EARNINGS

Ratio of investment to annual gross earnings.....	2:1	3:1	4:1	5:1	6:1
Earnings.....	100	100	100	100	100
Expenses, 40 per cent.....	40	40	40	40	40
Net earnings.....	60	60	60	60	60
Taxes, depreciation, etc.....	8	12	16	20	24
Return on investment.....	52	48	44	40	36
Per cent return.....	26	16	11	8	6
Earnings.....	100	100	100	100	100
Expenses, 50 per cent.....	50	50	50	50	50
Net earnings.....	50	50	50	50	50
Taxes, depreciation, etc.....	8	12	16	20	24
Return on investment.....	42	38	34	30	26
Per cent return.....	21	12.7	8.5	6	4.3
Earnings.....	100	100	100	100	100
Expenses, 60 per cent.....	60	60	60	60	60
Net earnings.....	40	40	40	40	40
Taxes, depreciation, etc.....	8	12	16	20	24
Return on investment.....	32	28	24	20	16
Per cent return.....	16	9.3	6	4	2.7
Earnings.....	100	100	100	100	100
Expenses, 70 per cent.....	70	70	70	70	70
Net earnings.....	30	30	30	30	30
Taxes, depreciation, etc.....	8	12	16	20	24
Return on investment.....	22	18	14	10	6
Per cent return.....	11	6	3.5	2	1
Earnings.....	100	100	100	100	100
Expenses, 80 per cent.....	80	80	80	80	80
Net earnings.....	20	20	20	20	20
Taxes, depreciation, etc.....	8	12	16	20	24
Return on investment.....	12	8	4	0	
Per cent return.....	6	2.7	1	0	

Assuming different ratios of expenses and of capital invested to the earnings, and expressing the investment as a multiple of the gross, results under the different conditions are as shown by Table XXXIV.

This table shows for any operating ratio how the return increases as the ratio of the investment to the earnings is reduced, and conversely for each ratio of investment to earnings how the return increases as we lower the operating ratio.

When the charges for taxes and for depreciation have the values used in this example, namely, $1\frac{1}{2}$ per cent and $2\frac{1}{2}$ per cent, respectively, the values of investment and operating ratios for which the yield on the investment is 6 per cent are easily remembered. If, instead of stating the ratio of expenses to gross earnings in percentage, it is expressed on a scale of 10, we find that the operating ratio and the limiting ratio of investment always total 10. Thus for 40 per cent operation the expenses are 4 and the corresponding investment ratio 6; for 70 per cent, 7 and 3, respectively, and so on. This is true for intermediate values, so a company operating at 56.32 per cent will not return 6 per cent if the investment is more than 4.368 times the earnings. This simple relation holds, of course, only when the annual charges for taxes, depreciation, and so forth total 4 per cent of the investment, but it is of interest as this is a representative figure for railway and lighting companies, and 6 per cent is probably the minimum average return at which capital can be induced to invest in the securities of public service corporations even under favorable conditions of size and stability, except possibly in those states where, as in Massachusetts, tax conditions create an artificial value for the stocks of tax-exempt companies.

The same results are shown if we consider the problem analytically. The amount which can be distributed among the investors is evidently that portion of the earnings which remains after operating expenses and taxes have been paid and suitable amounts set aside for depreciation, sinking fund, obsolescence, etc. Hence, if we let

$$G = \text{gross earnings}$$

$$E = \text{expenses} \div \text{gross earnings}$$

$$I = \text{investment} \div \text{gross earnings}$$

$$T = \text{taxes} \div \text{investment}$$

$$D = \text{depreciation, etc.} \div \text{investment}$$

$$R = \text{return} \div \text{investment}$$

then

$$EG = \text{operating expenses}$$

$$IG = \text{investment}$$

$$TIG = \text{taxes}$$

$$DIG = \text{depreciation, etc.}$$

$$R = \frac{G - EG - TIG - DIG}{IG} \text{ or } R = \frac{1 - E}{I} - T - D$$

Evidently with E constant the value of R will increase with a reduction in I and conversely; that is, for any operating ratio the return increases as the ratio of investment is reduced, while for each ratio of investment to earnings there is a gain in the return as we lower the operating ratio. Transposing in the last equation, we have:

$$R + T + D = \frac{1 - E}{I}$$

If the charges for taxes and depreciation and the return on the investment total 10 per cent, that is

$$R + T + D = 10$$

we have

$$\frac{1}{10} = \frac{1 - E}{I}$$

$$I = 10 - 10E \quad \text{or} \quad I + 10E = 10$$

That is, if we express the ratio of the expenses to the earnings on a scale of 10, the operating ratio and the limiting ratio of investment always total 10. This relation will evidently hold for any values of taxes, depreciation, and return which make the sum of the three 10 per cent; hence it holds for taxes $1\frac{1}{2}$ per cent, depreciation and so forth, $2\frac{1}{2}$ per cent, and return 6 per cent.

The accompanying Fig. 33 shows the relation between the operation, investment ratio, and return on the investment.

The ratio between the initial capitalization of a company and the gross earnings of its first year will commonly exceed that yielding 6 per cent, partly because the initial investment usually anticipates future growth and a consequent increase in return, and partly because it is customary to divide the investment between bonds and stock, that interest need be paid at the start on only a portion of the entire amount invested, the return on the remainder being deferred until the earnings have increased sufficiently to permit the payment of dividends.

Further increases in the investment should, however, be avoided if possible, unless an adequate return can be secured on the additional capital required, as the value of the whole business will be increased only if the additions and changes in investment, earnings, and expenses combine to maintain a rate in excess of the lowest rate of return at which investors will contribute capital. A street-railway company serving a growing community often finds it necessary to anticipate the

future growth of the community when planning extensions, for a failure to do this will cause public criticism and possibly result in competition or municipal ownership; it finds it difficult to estimate the earnings from a new generator made necessary by the growth of the business, and it finds it even harder to see profit in street paving or placing wires underground. Evidently such items cannot be considered separately, for they are each a necessary part of the growth of the whole business and the deficit resulting from any one must be offset by the increase in

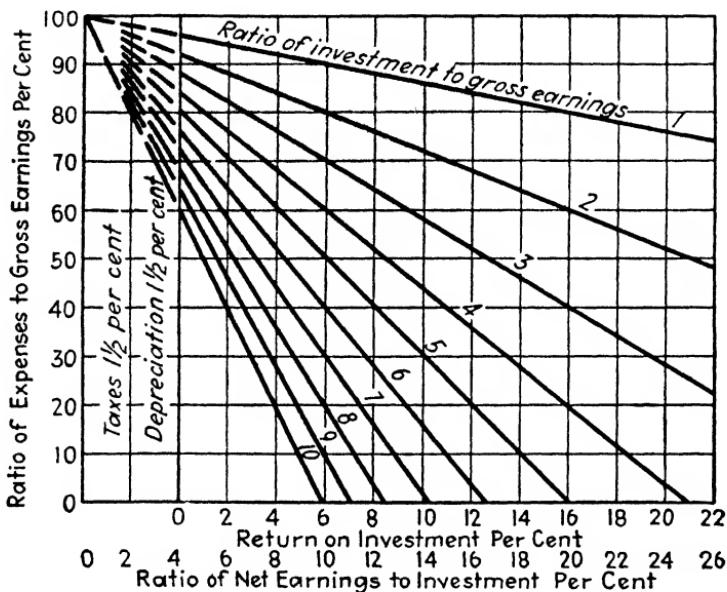


FIG. 33.—Return on investment.

return from the natural growth of the business and from extensions which show an immediate profit.

To avoid fluctuations in the rate of return it is evidently necessary that the increases in investment be timed to correspond with the increases in earnings. It sometimes happens, however, that it is not possible to keep the increase in investment during any one year down to the amount permitted by the growth in the earnings. Our street-railway company, for example, may be forced by the local government to undertake work which would otherwise be deferred; a new car barn or power station or an extension to a distant suburb may call for a larger expenditure during one year than the increase in earnings will justify; yet the work cannot be subdivided or spread over a longer period. When this occurs the company must endeavor to defer further expenditures until the earnings have increased sufficiently to justify

them, or to secure a reduction in the expenses sufficient to offset the added charges, for if the rate of return be diminished over a period of years it will result in a reduction in the value of the securities of the company and a probable narrowing of the market in which future issues can be placed.

An increase in earnings justifies a definite increase in investment, the amount depending upon the nature of the business, the operating ratio of the company, and the return which must be made to attract the additional capital. It then remains to decide how this additional investment shall be used. If the enterprise be a street-railway company and the community requires that it expend a portion of the additional capital for paving and the attendant rehabilitation of the track on the streets affected, the amount available for new cars, additional track, and other improvements and extensions to the service is correspondingly reduced. Moreover, the paving cannot produce additional earnings, while the new cars or track will bring in additional revenue which will, in turn, warrant a further addition to the investment. Hence, a community which requires its public service corporations to make large expenditures for unproductive improvements cannot fairly expect as low rates, or for equivalent rates cannot secure the same standard of service and rate of growth as is given to a community where the requirements are less burdensome.

The effect of a rapid increase in the investment and the consequent reduction in the return is well illustrated in the growth and development of the traction company of a commercial center of the West. In 1901 a company formed by a syndicate of local businessmen took over the existing street-railway system, believing that the service of the road had not kept pace with the growth of the community and that a more liberal policy would benefit both the city and the railway company. Plans were, therefore, made for the rehabilitation and extension of the entire system.

The company started with an investment of \$500,000 and annual earnings of \$150,000, the results for the first year considered being:

Earnings.....	\$ 150,000
Expenses, 60 per cent.....	90,000

Net earnings.....	\$ 60,000
Taxes, depreciation, etc.....	20,000

Return on investment.....	\$ 40,000
Per cent return.....	8

During the next year, \$115,250 was expended for reconstructing and extending the property. The city government thought this an opportunity to pave certain of the principal streets, the traction company,

of course, paying its portion of the cost. This added \$42,250 to the investment, which now totaled \$657,500. Additional business was, of course, secured, part coming from the natural increase in density of traffic on the existing lines, and requiring little added investment, and the remainder from the additions which gave added service or reached new territory. The gain in gross from these two sources was \$35,000, or nearly 25 per cent of the first year's business. The yield on the added capital was approximately 5 per cent, as the increase in investment was \$4.50 for each dollar of added earnings ($\$157,500/\$35,000 = 4.5$), which with 60 per cent operation yields 4.9 per cent on the investment. If the operating ratio remained unchanged, the results of the increase in business would be:

Earnings.....	\$35,000
Expenses, 60 per cent.....	21,000
<hr/>	
Net earnings.....	\$14,000
Taxes, depreciation, etc.....	6,300
<hr/>	
Return on investment.....	\$ 7,700 or 4.9%

The management saw, however, that if the operating ratio could be reduced it would increase the return from the original business, and this added return would tend to overcome the deficit on the new business, thus increasing the return of the whole undertaking. Every effort was accordingly made to cut expenses, with the result that the company operated for 58 per cent during the second year. Separating the original business from that added during the second year gives results as follows:

	First year's business	Obtained during second year	Total
Earnings.....	\$150,000	\$35,000	\$185,000
Expenses, 58 per cent.....	87,000	20,300	107,300
<hr/>			
Net earnings.....	\$ 63,000	\$14,700	\$ 77,700
Taxes, depreciation, etc.....	20,000	6,300	26,300
<hr/>			
Return on investment.....	\$ 43,000	\$ 8,400	\$ 51,400
Per cent return.....	8.6	5.3	7.8

Continuing the policy of improvement and extending the company's system, \$275,000 was added to the investment during the third year, while the increase in earnings during the same period was \$55,000, a

ratio of 5:1. Evidently the new business would show a return of only about 4½ per cent, which low rate was only partially offset by a further decrease of 2 per cent in the operating ratio, making the results of the third year:

	First year's business	Obtained in second year	Obtained in third year	Total
Earnings.....	\$150,000	\$35,000	\$55,000	\$240,000
Expenses, 56 per cent.....	84,000	19,600	30,800	134,400
Net earnings.....	\$ 66,000	\$15,400	\$24,200	\$105,600
Taxes, depreciation, etc.....	20,000	6,300	11,000	37,300
Return on investment.....	\$ 46,000	\$ 9,100	\$13,200	\$ 68,300
Per cent return.....	9.2	5.8	4.8	7.3

During the fourth year earnings increased \$30,000, while \$105,000 was added to the investment, which now totaled \$1,037,000. The ratio of the cost of the new work to the increased earnings was 3.5:1, so the return on the added investment was over 8 per cent. This gain was, however, offset by an increase of 1 per cent in the operating ratio made necessary by the economies of the preceding years. The report for the year showed:

Earnings.....	\$270,000
Expenses, 57 per cent.....	153,900
<hr/>	
Net earnings.....	\$116,100
Taxes, depreciation, etc.....	41,500
<hr/>	
Return on investment.....	\$ 74,600
Per cent return.....	7.2

The annual meeting of the company this year was attended by the senior partner of the New York firm of bankers who had placed the bond issue of the company. This gentleman pointed out to the management that, while the earnings had increased 80 per cent during the past four years, the return on the investment had decreased from 8 per cent to 7.2 per cent. He recommended that the company postpone further investment until that already made showed a fair return.

Acting upon this advice, further extensions were curtailed and during the fifth year only \$55,000 was expended on the property, this amount being used for some paving, some small items of miscellaneous construc-

tion, and for the completion of the work started the previous year. The earnings continued to increase rapidly from the extensions which had been made, the gain during this year being \$38,000. The added business would evidently show a substantial profit, as the added investment was only $1\frac{1}{2}$ times the gain in earnings ($\$55,000/\$38,000 = 1.45$). The operation was kept to 57 per cent, making the results:

Earnings.....	\$308,000
Expenses, 57 per cent.....	175,560

Net earnings.....	\$132,440
Taxes, depreciation, etc.....	43,700

Return on investment.....	\$ 88,740
Per cent return.....	8.1

During the sixth year only \$16,000 was added to the amount invested in the property, while the earnings increased \$32,000, the addition to the investment being only one-half of the increase in earnings, so the company was assured a substantial profit from the added business. Operating expenses had been cut quite closely during the previous five years, and it was evident that it would soon be necessary to expend rather large amounts for maintenance. In the sixth year it seemed opportune to do this, and approximately \$10,000 was expended on the property, with the result that the operating ratio rose to 61 per cent, the showing for the year being:

Earnings.....	\$340,000
Expenses, 61 per cent.....	207,400

Net earnings.....	\$132,600
Taxes, depreciation, etc.....	44,340

Return on investment.....	\$ 88,260
Per cent return.....	7.9

During the seventh year the community experienced a severe business depression, and it was apparent that unless extraordinary precautions were taken the return would be seriously diminished. It was evidently impossible to make any material reduction in money borrowed or in taxes, for the investment had been made and, of course, interest and taxes could not be stopped. The efforts must, therefore, be directed toward reducing expenses and preventing any increase in the investment. New construction was, accordingly, cut as low as possible, only \$9,600 being expended during the year, and every effort was made to secure a

saving in expenses equal to the loss in earnings, which amounted to \$28,000. This was, of course, very difficult, for in many cases the service could not be reduced without causing a still further loss of business, but a substantial cut was made and the expenses were \$27,000 less than the previous year, the showing being:

Earnings.....	\$312,000
Expenses, 57.7 per cent.....	180,030
<hr/>	
Net earnings.....	\$131,970
Taxes, depreciation, etc.....	44,724
<hr/>	
Return on investment.....	\$ 87,246
Per cent return.....	7.8

Toward the end of the eighth year the company partially recovered from the effects of the depression and the gross increased \$17,500 over the year before. The expenses were 58 per cent, and as only \$12,000 was added to the investment there was a substantial increase in profit, the results of the year's operation being:

Earnings.....	\$329,500
Expenses, 58 per cent.....	191,110
<hr/>	
Net earnings.....	\$138,390
Taxes, depreciation, etc.....	45,204
<hr/>	
Return on investment.....	\$ 93,186
Per cent return.....	8.2

During the ninth year the business of the community regained its former vigor, and the earnings of the traction company increased \$40,500 over the preceding year, while the expenses were kept at 57 per cent; \$35,000 was expended for new construction, the ratio being approximately 9:1, so the new business added largely to the profit. During this year the company obtained the largest earnings and showed the largest profit of any year in its history, the figures being:

Earnings.....	\$370,000
Expenses, 57 per cent.....	210,910
<hr/>	
Net earnings.....	\$159,090
Taxes, depreciation, etc.....	46,640
<hr/>	
Return on investment.....	\$112,450
Per cent return.....	9.6

At the end of the ninth year the city has grown and the business of the company has developed to such an extent that a demand now exists for further extensions, which, of course, will call for corresponding additions to the power station, carbarn, and so forth. Plans for these extensions have been made, but in the light of the company's previous experience, the work will be more evenly spread over a number of years, instead of all being undertaken at one time as was done in the second year and the third year. While the ultimate results will be the same, this course will avoid impairing the showing of the company during the years when the bulk of the construction is done.

It is instructive to compare the results of the first four years with those of the last five:

	1st year	4th year	9th year
Earnings.....	\$150,000	\$ 270,000	\$ 370,000
Expenses.....	90,000	153,900	210,910
Net earnings.....	\$ 60,000	\$ 116,100	\$ 159,090
Taxes, depreciation, etc.....	20,000	41,500	46,640
Return on investment.....	\$ 40,000	\$ 74,600	\$ 112,450
Investment.....	500,000	1,037,500	1,166,000
Per cent return.....	8	7.2	9.6

	Increase 4th year over 1st	Increase 9th year over 4th
Earnings.....	\$120,000 or 80 %	\$100,000 or 37 %
Expenses.....	63,900 or 71 %	57,010 or 37 %
Net earnings.....	\$ 56,100 or 93 %	\$ 42,090 or 37 %
Taxes, depreciation, etc.....	21,500 or 108 %	5,140 or 12 %
Return on investment.....	\$ 34,600 or 86 %	\$ 37,850 or 51 %
Investment.....	537,500 or 107 %	128,500 or 12 %
Per cent return.....	Decrease 0.8	2.4

The increase in the gross and net earnings during the first period and the accompanying reduction in the operating ratio from 60 per cent in first year to 57 per cent in 1904 were most gratifying. This gain was offset by the increase in the charges due to the money expended in improving the property and extending the company's lines, with the

result that while the gross increased 80 per cent the rate of return on the whole investment was reduced.

Now if the company had made no increase in gross earnings over 1901 and hence had not required additional capital, but had been able to reduce its operation to 57 per cent, which was the actual figure in the fourth year, the results of operation for that year would have been:

Earnings.....	\$150,000
Expenses, 57 per cent.....	85,500
Net earnings.....	\$ 64,500
Taxes, depreciation, etc.....	20,000
Return on investment.....	\$ 44,500
Per cent return.....	8.9

Evidently such a policy would have increased the yield on the original investment and hence have added to the value of the business. It is doubtful, however, if the increase in value would have been as great as that which occurred under the policy which the company actually followed, as this made possible an increase in the size of the business which resulted in a broader market for its securities, and gave additional opportunity to invest capital at a desirable rate of return.

From the fourth to the ninth year a much more conservative policy was adopted. While the earnings increased 37 per cent the increase in investment was only 12.4 per cent, so the returns were from 7.2 to 9.6 per cent. . . . It is necessarily assumed that all portions of the business have the same operating ratio during any given year, and that the increase in the investment occurring during that year was required to obtain this additional business.

It would have been possible to equalize the rate of return of the different years somewhat by diminishing the amount set aside during the earlier period to take care of the depreciation of the property and increasing the charge correspondingly during the later years. This was considered by the management, but it was not done as it was realized that such action would be only a makeshift which could not be continued for any considerable period without impairing the value of the property and its securities. . . . To secure successful development of any growing enterprise it is necessary that the following points be kept clearly before the management, and, if the enterprise is a public service corporation, they should also be appreciated by the community it serves:

1. An increase in earnings justifies a definite increase in investment, the amount depending on the nature of the business, the operating

ratio of the company, and the return which must be made to attract capital.

2. The various items of investment cannot be considered separately for they are each a necessary part of the growth of the whole business. The value of the enterprise will be increased only if all additions and changes in investment, earnings, and expenses combine to yield a satisfactory return on the investment.

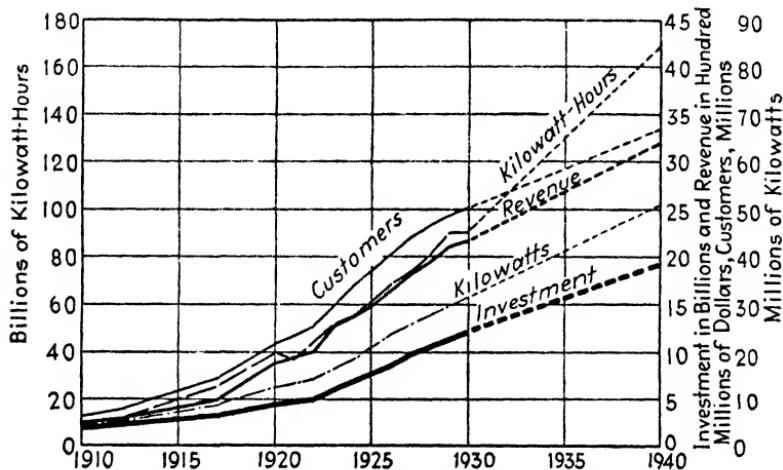


FIG. 34.—Two decades of the light and power industry.

3. To avoid fluctuations in the rate of return it is necessary that increases in investment be timed to correspond with increase in earnings, or, if this is impossible, that the expenses be reduced at the time of such increase sufficiently to offset the added charges.

4. If the additional investment is expended for productive extensions, further investment will be justified because of these added earnings and the property will grow rapidly. If, however, the added money goes wholly or in part for unproductive work, or if the expense ratio is increased due to reduction in rates, the growth of the company will be retarded and the service which it can give impaired.³

Reference to the accompanying Figs. 34 and 35 will be found of value not only in determining the history of the ratio between revenue and investment *in toto*, per unit customer and per kilowatt, but also in indicating by extrapolation of the trend graphs what the corresponding values are likely to be in the year 1940. Such trend curves are of particular interest during periods of economic depression, such as the years 1920–1921 and 1929–

1936, for, although slight temporary changes in the slope of the graphs take place, the general upward trend is usually maintained over a long period of years, which lends authenticity to the predictions that the engineer must undertake in order to prepare adequately for further demands. It should be noted that, although the central station load has again (1935) reached its old value, the depression has caused considerable departure from the financial predictions, as of January, 1931, shown in this graph.⁴

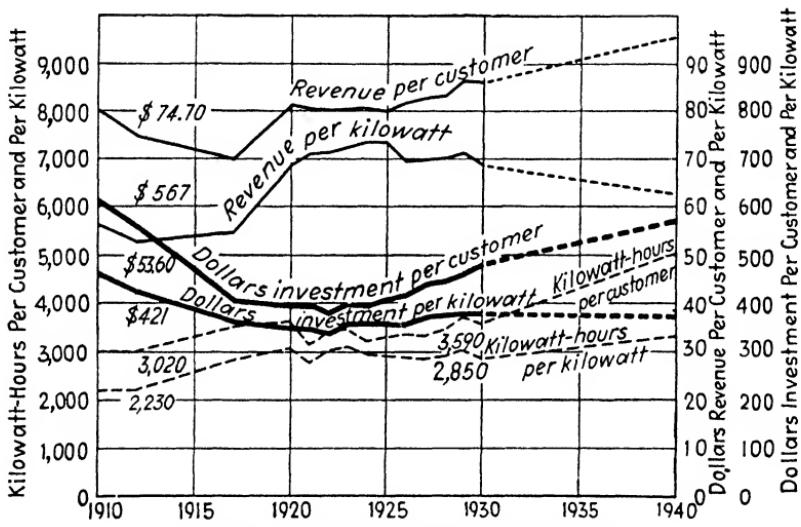


FIG. 35.—Utility unit values change slightly.

Another problem of the public utility engineer and manager is that of maintaining approximately the same, or lower, operating ratios in the face of varying gross revenue; in other words, he must "cut his cloth to fit" his reduced earnings. That this can be and has been done in many cases during the years 1930 to 1935 is well illustrated by the gross and net earnings of Table XXV, recorded by *Electrical World* for a few typical light and power systems.⁵

In thus attempting to maintain or lower standards of operating ratio, the comparison may be made to advantage from year to year with similar ratios of the particular company in which the executives are interested, provided that no marked reorganization or change of policy has taken place in the meantime. Another

source of convenient comparison is that with the average, or, better, the modal ratios of groups of other companies of similar size and type of business, preferably in the same section of the country, or at least those operating in the same type of environment.

Useful, therefore, by way of comparison, are the modes and frequency distributions of operating ratios which have been prepared by the Bureau of Business Research of the University of Illinois.⁶ Therein the mode of operating ratios of 1,698 cases representing 200 utility companies, exclusive of telephone and municipally owned utilities, during the years 1915 to 1924, was 72 per cent. In other words, 28 per cent of their gross revenue was available for fixed charges, dividends, additions to surplus, and other expenditures.

This mode also excludes 50 companies whose ratio was over 100 per cent, i.e., those in which the operating expense was greater than the gross income, obviously a very abnormal and questionable managerial policy. Furthermore, it is interesting to note that 54 per cent of all of the cases had operating ratios falling between 64 and 87 per cent. With respect to geographical distribution of the companies, this investigation shows the highest operating ratios in the Middle West (73 per cent mode) and the lowest in the South (63 per cent). The study of the effect of the size of the companies upon operating ratio indicates that both the smallest group of companies, with assets from \$5 to \$9 millions, and the largest group, with assets over \$50 millions, approximate the 72 per cent ratio closely while the companies ranging from \$10 to \$49 millions hover about a mode of only 68 per cent. Traction companies, probably because of their recently reduced patronage and high labor costs, have, in general, operating ratios of 76 per cent while the electric and gas utilities group around a mode of 71 per cent. The effects of prosperous and depressed financial years upon operating ratios are indicated by the fact that in 1917 (a war year) the ratio was 65 per cent; in 1919 (a postwar boom year) 70 per cent; in 1921 (a depression year) 74 per cent; in 1924 (a year of recovery) the mode had dropped to 68 per cent.

Thus, we see that the public utility manager and the board of directors must operate within rather circumscribed limits. The net return is established by a state commission; the operating

TABLE XXXV.—CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND
POWER COMPANIES
Operating Companies

	1931	1930	Per cent increase	Operating ratio	
				1931	1930
Birmingham Electric (Year ended Oct. 31)					
Gross earnings.....	\$ 7,499,977	\$ 8,419,922	-11.0	69	70
Net earnings.....	2,321,295	2,612,937	-11.0		
Carolina Power & Light (Year ended Oct. 31)					
Gross earnings.....	9,654,195	8,949,747	8.0	49	44
Net earnings.....	4,940,901	4,998,507	-1.0		
Houston Lighting & Power (Year ended Oct. 31)					
Gross earnings.....	8,537,188	8,798,005	-3.0	47	52
Net earnings.....	4,549,421	4,223,657	8.0		
Memphis Power & Light (Year ended Oct. 31)					
Gross earnings.....	7,007,110	6,739,530	4.0	58	59
Net earnings.....	2,909,132	2,759,662	5.0		
Montana Power (Year ended Oct. 31)					
Gross earnings.....	8,841,378	10,616,708	-17.0	41	39
Net earnings.....	5,261,114	6,510,017	-19.0		
Northwestern Electric (Year ended Oct. 31)					
Gross earnings.....	3,596,606	3,721,439	-3.0	58	60
Net earnings.....	1,510,859	1,510,389	1.0		
Pacific Power & Light (Year ended Oct. 31)					
Gross earnings.....	4,707,384	4,430,113	6.0	52	51
Net earnings.....	2,235,684	2,182,111	2.0		
Pennsylvania Power & Light (Year ended Oct. 31)					
Gross earnings.....	34,434,853	30,880,068	12.0	49	49
Net earnings.....	17,614,614	15,692,631	12.0		
Southern California Edison (11 months ended Nov. 30)					
Gross earnings.....	37,504,885	37,798,911	-0.8		
Net earnings.....	24,797,773	25,587,761	-3.1		
Texas Electric Service (Year ended Oct. 31)					
Gross earnings.....	8,449,778	9,212,410	-8.0	49	48
Net earnings.....	4,347,124	4,795,540	-9.0		
Texas Power & Light (Year ended Oct. 31)					
Gross earnings.....	9,951,108	9,966,601	-0.0	48	48
Net earnings.....	5,170,296	5,136,355	1.0		
Washington Water Power (Year ended Oct. 31)					
Gross earnings.....	8,996,184	9,466,823	-5.0	47	44
Net earnings.....	4,818,525	5,326,789	-10.0		

Holding Companies

American & Foreign Power and subsidiaries (Year ended Sept. 30)					
Gross earnings.....	\$89,458,189	\$77,351,407	-10.2	49	50
Net earnings.....	35,428,605	38,606,501	-8.2		

expenses must be kept within a narrow range with respect to gross revenue, and the gross revenue itself is, in turn, dependent upon the rates to be charged for the service to the consumers. These rates are also subject to the approval of the state commission. Hence, there is demonstrated the necessity of careful analyses of operating ratios and the detailed study, on the part of engineers and engineering executives, of the subdivision and allocation of gross revenue, which will be found under the titles of Allocation of Valuation and Fixed Charges, Chap. XVIII, and Rate Base and Rate Schedules, Chap. XXVIII.

Specific References

1. Annual Report American Telephone and Telegraph Company.
2. "Light and Power Industry Continues Its Progress," *Elec. World*, Jan. 2, 1932.
3. DANIELS, NATHAN H., JR.: "The Relation of Investment, Earnings and Expenses in a Growing Business," Stone and Webster, *Pub. Service J.*, vol. 9, p. 89-107. See also WALTER E. LAGERQUIST, "Public Utility Finance" (1927), p. 439, McGraw-Hill Book Company, Inc., New York.
4. "Two Decades of the Light and Power Industry Foretell 1930-1940 Growth," *Elec. World*, Jan. 3, 1931.
5. *Elec. World*, Jan. 2, 1932.
6. "The Disposition of Income in Public Utility Companies," *College of Commerce and Business Admin. Bull.* 13, University of Illinois, 1927.

Review Questions

1. A public utility property may be capitalized and operated with one of the three plans *X*, *Y*, or *Z* shown on page 410. Calculate separately for each condition of capitalization *X*, *Y*, and *Z*:
 - a. Gross revenue?
 - b. Operating ratio?
 - c. Ratio valuation to gross revenue?
 - d. Face value of bond issue?
 - e. Cash realized from sale of bonds?
 - f. Fair return?
 - g. Bond interest?
 - h. Remainder of fair return available for dividends and surplus?
 - i. Preferred-stock dividend?
 - j. Par value of preferred-stock issue?
 - k. Cash realized from sale of preferred stock?
 - l. Balance of cash to be raised from common stock?
 - m. Par value of common-stock issue?
 - n. Common-stock dividend available in (1) dollars and (2) per cent ($= n/m$ per cent)?
 - o. Surplus in dollars?

- p. Total capitalization (par value)?
- q. Ratio of capitalization to gross revenue?
- r. Per cent over capitalization?

	X	Y	Z
Valuation (appraised).....	\$3,000,000	\$3,000,000	\$3,000,000
Book or cash value.....	3,000,000	3,500,000	3,500,000
Allowable fair return.....	7 % on valuation	7 % on book value	7 % on valuation
Operating expense.....	420,000	450,000	450,000
Depreciation.....	120,000	120,000	120,000
Fixed charges, exclusive of interest, dividends, and depreciation.....	90,000	90,000	90,000
Bond issue (5 % interest).....	70 % valuation	70 % book value	70 % valuation
Bond-sale discount, per cent.....	15	15	15
Preferred stock (7 %).....	*	*	*
Preferred-stock sale discount, per cent.....	10	10	10
Common stock (at 80).....	Remainder of book value in all cases.		
Common-stock dividend.....	Half of net income balance in all cases.		

* Preferred stock issued such that 7 per cent dividend is earned one and one-half times after bond interest has been deducted from fair net return.

2. A telephone company is appraised at \$100 per station and has 12,000 stations. Its valuation turnover is 5 to 1 and its operating ratio (including depreciation) is 60 per cent. The fair return allowed by the commission is 7 per cent of the valuation.

- a. Calculate the remainder of the fixed charges.
 - b. If the financial setup provided that 5 per cent bonds were issued at 90 per cent of par up to the amount that the bond interest was earned exactly twice over, what would be the total face value of the bonds?
 - c. Accumulative preferred stock is also to be issued and sold at 85 per cent of par up to the amount that the 7 per cent dividends shall not exceed two-thirds of the remaining net income after deducting the bond interest. What is the par value of the preferred?
 - d. The balance of the valuation is to be raised by the sale of common stock at 80 per cent of par. If one-half of the remaining net income, after taking care of items (b) and (c) above, is put into a surplus, what is the per cent return on the common stock?
 - e. Determine the per cent over capitalization of this company.
3. A corporation has a cash valuation of \$100,000 with outstanding common stock of \$70,000 and a gross revenue of \$25,000 per annum. Its

operating expenses are \$15,000 and its 5 per cent bond interest is \$3,000 per annum.

- a. What is its operating ratio?
 - b. What is the maximum possible common-stock dividend?
 - c. How much is it overcapitalized?
 - d. If a straight-line depreciation fund of 5 per cent is established for the true valuation, what will happen to the maximum possible stock dividend?
 - e. If, in addition to (d), the directors decide to put one-half of the net income, after bond interest and depreciation, into surplus, what becomes of the common-stock dividend?
4. A certain public utility is appraised at \$2,000,000. An audit of the books shows a *capitalization* turnover of 4.5 to 1. The operating expenses are \$290,000. Insurance and taxes total 2 per cent. The capitalization is as follows: \$1,000,000 of 5 per cent bonds sold at par, \$600,000 of 6 per cent preferred sold at 90, and \$575,000 (par value) of common stock. It is agreed that a fair return of 6 per cent should be earned in addition to 4 per cent depreciation.
- a. What adjustments should be made to the rates? Why?
 - b. What is the operating ratio and what does it signify? Is this a good ratio?
 - c. What profit has been earned during the year? What should it be?
 - d. What per cent dividend can be declared to the holders of common stock?
 - e. By what per cent is this company overcapitalized?
5. A corporation has a capital turnover once in five years. Its gross revenue is \$2 million per annum and its operating ratio is 55 per cent. The depreciation is allowed as 3 per cent of the capitalization and is not included in the operating expense. The corporation is financed with 62.5 per cent of 5 per cent bonds, 25 per cent of 7 per cent preferred, and 12½ per cent of common—all sold at par.
- a. What percentage of fair return has been earned on the capitalized value?
 - b. What is the maximum common-stock dividend that could be paid, in per cent?
6. A company plans to buy a utility costing \$5,000,000. This money is to be raised from the sale of bonds, preferred stock, and common stock. The net income from this plant is estimated at \$400,000 per annum.
- a. If the ratio of amount available for bond interest to interest requirements is 3 to 1, how many 5 per cent bonds can be sold at 105?
 - b. How much 6 per cent preferred stock can be issued at 98 if the ratio of bonds to preferred stock is 2:1?
 - c. How much common stock must be sold at 70 and what will be its maximum dividend?
7. A company has a cash capital of \$200,000. Seventy-five per cent of this capital is borrowed on bonds sold at 90 per cent on their face value. These bonds bear 4½ per cent annual interest. The remainder of the cash capital was secured from the sale of common stock at par. If the operating

expenses for the year are \$25,000, and the operating ratio is 60 per cent, what percentage dividend is possible for the common stock if an amount equal to this dividend is placed, by the directors, in the surplus fund?

8. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively?

- T F A bond issue of a company having a net income of one and one-fourth times anticipated bond interest is conservative.
- T F Generally speaking, the safer the investment, the higher the interest rate.
- T F The operating ratio is likely to decrease immediately during periods of depression.
- T F A public utility normally turns its capital over more frequently than a merchandising corporation.
- T F A reduction of operating ratio from 60 to 55 per cent results only from reduced operating expenses.
- T F The operating ratio of a public utility corporation is usually in the neighborhood of 10 per cent.
- T F Public utilities usually "turn over" their capital several times each year.
- T F The operating ratio of a public utility may be over 100 per cent.
- T F The gross revenue of a hydroelectric generating corporation usually bears a larger ratio to the investment than that of a corresponding steam plant.
- T F Operating ratio may be changed by varying either gross revenue or operating expenses.
- T F The ratio of investment to gross revenue is greater in a public utility than in most business corporations.
- T F A public utility company may be financially sound and yet turn over its capital only once in seven years.
- T F Load-building programs are designed to decrease the operating expense.
- T F Net income equal to bond interest is a dangerous financial situation for a company.
- T F A bond issue of 85 per cent of valuation is conservative.

CHAPTER XXI

NET INCOME, YIELDS, AND DIVIDENDS

From the gross revenue of a corporation in a given year the operating expenses (particularly wages and salaries which have one of the first claims thereon), taxes, insurance, maintenance, depreciation, and finally note and bond interest are subtracted, leaving the net income available for dividends and/or surplus as the directors may determine.

These various items, which unfortunately must intervene between gross revenue and net income, and which have been generally classified into the two distinct groups known as operating expenses and fixed charges, respectively, bear various ratios of comparative significance to capitalization and to the gross revenue itself.

Fortunately the executive, in his study of the variations of success of his corporation from year to year, and the investor, who is interested also in the status of market values and the yields available from the various corporate securities, have well-established references, tables, and ratios which have been well defined and standardized throughout recent years solely for such comparative and investment purposes. The young engineer and businessman should therefore early acquaint himself with the vast funds of financial information so well classified and indexed in such annual publications as Moody's Public Utilities, Moody's Industrials, Poor's Public Utilities, etc., which are available in any public library. The definitions of such ratios, in addition to those of Chap. XX, and sample tables established in these valuable references will therefore be quoted in some detail after their usefulness in adaptation to the following concrete analysis has been outlined.

Let us assume different corporations having investments of capital ranging from four to eight times the gross revenue taken in by the business in one year, i.e., the *capital turnover* ranges from four to eight years. Public utility corporations in general and

hydroelectric utilities in particular have relatively large investments per dollar of gross revenue, whereas a merchandizing corporation may turn over its capital several times per annum. One large electric light and power corporation varied, within a period of thirteen years, from \$3 to \$5.40 in its fixed capital per dollar of its annual gross revenue.

In the accompanying Table XXXVI five such ratios are assumed in the five columns, respectively. Basing the subsequent calculations upon the assumption of every \$100 gross revenue per annum, the actual cash investments indicated in the first line of the table are required.

Three types of capitalization policies are assumed as indicated by the three cases, *A*, *B*, and *C*, of the left column. *A* represents a rather questionable condition in which the ratio of net earnings to bond interest is allowed to become as low as $1\frac{1}{2}:1$, or, to state the case more logically in sequence, the corporation has been permitted (or required of necessity) to borrow capital on a bond issue to such an extent that the net earnings, after operating expenses, taxes, insurance, depreciation, and other fixed charges have been paid, are only $1\frac{1}{2}:1$ times the bond interest. Case *B* is more conservative, limiting this ratio to $1\frac{3}{4}:1$, while case *C* represents a still more stable financial policy with a $2:1$ ratio between net earnings and bond interest.

If case *A* is considered, by way of further illustration of the analysis of this important table, and the net profit, or return upon the investment, is limited to 7 per cent, as is usually the case in commission regulation of public utilities, then the net return in dollars per \$100 of gross revenue, and for the investment represented differently in each column, is found opposite "Net income at 7 per cent." Referring to the \$400 investment column, this provides \$28 net and, with the $1\frac{3}{4}:1$ ratio, a possible bond interest of $\$28/1.75 = \18.67 . Thus the difference $\$28 - \18.67 or $\$9.33$ is left for preferred- and common-stock dividends and for any surplus that may be allowed to accumulate as the result of the limitation, by the directors, of common-stock dividends.

Incidentally, the operating expenses, including all operation and fixed charges (exclusive of interest, dividends, and surplus), are $\$100 - \$28 = \$72$ per annum and the operating ratio is, of course, $\$72/\$100 = 72$ per cent.

TABLE XXXVI.—GROSS REVENUE AND ITS DISTRIBUTION
(7% Return, as Allowed by Public Service Commission)

	Investment in dollars per dollar of gross revenue				
	4	5	6	7	8
Case A. Ratio net earnings to bond interest, 1½:1					
5 per cent bonds sold at 80					
Stock sold at 75					
Gross revenue.....	\$100.00	\$100.00	\$100.00	\$100.00	\$100.00
Investment.....	400.00	500.00	600.00	700.00	800.00
Net income at 7 per cent.....	28.00	35.00	42.00	49.00	56.00
Operating expense.....	72.00	65.00	58.00	51.00	44.00
Operating ratio, per cent.....	72.00	65.00	58.00	51.00	44.00
Bond interest.....	18.67	23.33	28.00	32.67	37.33
Face value 5 per cent bonds.....	373.40	466.66	560.00	653.40	746.80
Proceeds from bonds at 80.....	298.72	373.33	448.00	522.72	597.28
Balance of cash to be raised from stock.....	101.28	126.67	152.00	177.28	202.72
Par value stock required at 75.....	135.04	168.90	203.00	236.37	270.29
Balance for stock or surplus.....	9.33	11.67	14.00	16.33	18.67
Maximum possible return on stock (per cent)	6.91	6.91	6.91	6.91	6.91
Case B. Ratio net earnings to bond interest, 1¾:1					
5 per cent bonds sold at 85					
Stock sold at 80					
Gross revenue.....	\$100.00	\$100.00	\$100.00	\$100.00	\$100.00
Investment.....	400.00	500.00	600.00	700.00	800.00
Net income at 7 per cent.....	28.00	35.00	42.00	49.00	56.00
Operating expense.....	72.00	65.00	58.00	51.00	44.00
Operating ratio, per cent.....	72.00	65.00	58.00	51.00	44.00
Bond interest.....	16.00	20.00	24.00	28.00	32.00
Face value 5 per cent bonds.....	320.00	400.00	480.00	560.00	640.00
Proceeds from bonds at 85.....	272.00	340.00	408.00	476.00	544.00
Balance of cash to be raised from stock.....	128.00	160.00	192.00	224.00	256.00
Par value stock required at 80.....	160.00	200.00	240.00	280.00	320.00
Balance for stock or surplus.....	12.00	15.00	18.00	21.00	24.00
Maximum possible return on stock (per cent)	7.50	7.50	7.50	7.50	7.50
Case C. Ratio net earnings to bond interest, 2:1					
5 per cent bonds sold at 90					
Stock sold at 85					
Gross revenue.....	\$100.00	\$100.00	\$100.00	\$100.00	\$100.00
Investment.....	400.00	500.00	600.00	700.00	800.00
Net income at 7 per cent.....	28.00	35.00	42.00	49.00	56.00
Operating expense.....	72.00	65.00	58.00	51.00	44.00
Operating ratio, per cent.....	72.00	65.00	58.00	51.00	44.00
Bond interest.....	14.00	17.50	21.00	24.50	28.00
Face value 5 per cent bonds.....	280.00	350.00	420.00	490.00	560.00
Proceeds from bonds at 90.....	252.00	315.00	378.00	441.00	504.00
Balance of cash to be raised from stock.....	148.00	185.00	222.00	259.00	296.00
Par value stock required at 85.....	174.12	217.65	261.17	304.71	348.23
Balance for stock or surplus.....	14.00	17.50	21.00	24.50	28.00
Maximum possible return on stock.....	8.04	8.04	8.04	8.04	8.04

However, the bonds can seldom be sold at their face value; at least some expense, if not actual discount, is involved in their sale, so that their face value is seldom realized in cash. The assumption is made, in this table, that they are sold at \$80 and that they bear 5 per cent interest, the latter, of course, applying upon their face value. The face value of the bond issue is, therefore, $\$18.67/0.05 = \373.40 and the cash secured from the sale of bonds is only $0.8 \times \$373.40 = \298.72 . Thus $\$400 - \298.72 or $\$101.28$ of the cash capital required must be secured by the sale of stock.

If stock must be sold at \$75, i.e., at 25 per cent discount over its par value, it will require a total value of $\$101.28/0.75 = \135.04 for the stock to provide the necessary cash capital.

Now, assuming the most favorable possible condition for the stockholders, i.e., that no surplus is provided and that the directors pay all the possible net earnings to the stockholders, the maximum possible, although financially dangerous, return to the common stockholder is $\$9.33/\$135.04 = 6.91$ per cent on the face value or $6.91/0.75 = 9.2$ per cent on the actual investment in cash which the stockholder made in buying the stock at \$75. If, as is usually the case, the directors reserve at least one-half of the net profits for reserve funds and other portions of surplus, the return to the stockholder is reduced to 3.455 and 4.6 per cent, respectively, which is less than bond interest and not an attractive yield in consideration of the risk and possible variations involved from year to year.

However, a glance at the more conservative cases *B* and *C* will show a more favorable maximum possible return upon the par value of common stock of 7.5 and 8.04 per cent, respectively. Furthermore, it should be noted that no preferred stock has been included between the bonds and the common stock in this capitalization. Such stock would, if issued normally, reduce still further the return on the common stock, although such assumptions of ratios and discounts required for sale might be made as to improve the status of the common stockholder.

The curves on the accompanying chart (Fig. 36)¹ not only summarize the important items resulting from the hypothetical cases of Table XXXVI with respect to "Dollars of Fixed Capital per Dollar of Revenue" as abscissas and "Per cent Earned on Fixed Capital" as ordinates for various operating ratios, but

they also indicate the points within this field where such ratios appeared for one of the largest electric light and power companies of the country during specified years in the past.

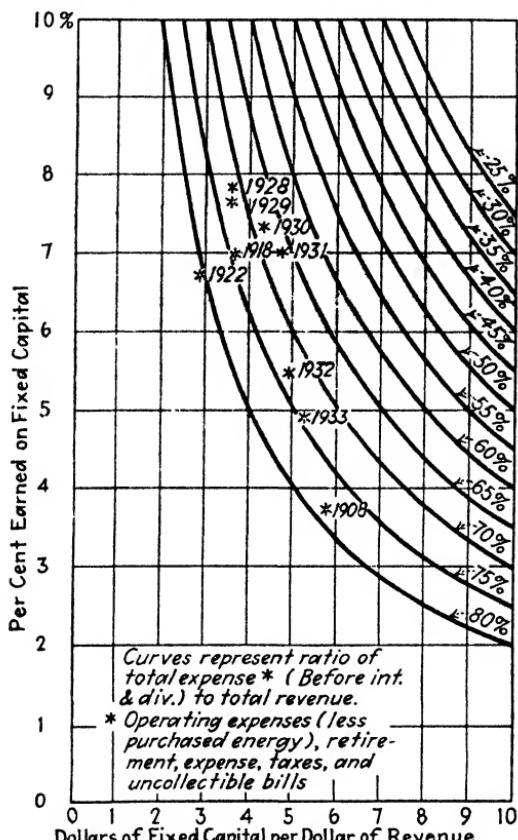


FIG. 36.—Rate of return on fixed capital.

Some of the pertinent comments upon these data which will be evident from a study of the table are:

Ratios Pertaining to Profits.—Operating expense to revenue (operating ratio) expresses the operating efficiency of the company, a low ratio indicating low operating and maintenance costs. Such a condition may be due to a high investment resulting in high fixed charges, so both the operating and investment efficiencies should be correlated to determine the return on the fixed capital, as will be discussed below under "Rate of Return on Fixed Capital."

"Retirement Expense to Revenue" expresses the percentage of the total revenue which has been added to the retirement reserve during the year for the future replacement of equipment.

"Net Income to Revenue" expresses the profits earned on the sale of electricity after all charges including taxes, but before interest and dividends.

The number of times over that the bond interest has been earned expresses the cushion in the form of reserve earnings that was available for the bondholders, and reflects the earning power of the company.

Rate of Return on Fixed Capital.—"Total Expense to Revenue" expresses the percentage of the revenue which has been expended on operating, maintenance, retirement, taxes, and all other charges except interest and dividends. This ratio, when used in conjunction with the number of dollars of fixed capital invested to produce a dollar of revenue, measures the percentage return on the fixed capital.

The graph, Fig. 36, summarizes the results from operation over a period of years and enables the executive to visualize the earning possibilities at the various operating and investment efficiencies. The scale on the horizontal axis refers to the investment efficiency (dollars of fixed capital per dollar of revenue). The curves on the graph represent the operating efficiency (total expense to revenue ratio). The earnings on the fixed capital that will result from any combination of these efficiencies can be read on the vertical axis. For instance, in 1922 when the investment efficiency of \$3 of fixed capital per dollar of revenue is superimposed along the 80 per cent curve representing the operating efficiency, the reading on the vertical axis will be 6.8 per cent, which was the percentage earned on the fixed capital in that year. If it took \$4 of fixed capital to produce \$1 of revenue, with the same operating efficiency it can be seen at a glance that the earnings would be 5 per cent.¹

The "yield" to the investor may be considered as the "cost of money" to the corporation. Some of the factors that govern the cost of money to the corporation, as described below by O. B. Willcox, vice-president of Bonbright & Company, Inc., may be equally valuable in determining the variations of yields.²

Uncertainties as to safety of principal or income add to the cost of money, and such uncertainties sometimes arise from reappraisal of property values and changes in policy in fixing the rate of return. Some of the commissions show an inclination to recognize outstanding capitalization, when once supported by appraisals, and to fix the rate of return so as to produce interest and dividends on the approved capital and additions made under the eye of the commissioners. This policy should

be encouraged and its adoption facilitated by proper presentation of the subject matter in rate hearings.

Fear of the impairment of capital adds to the cost of money. Capital invested in utilities is entitled to protection against impairment through wear and tear and obsolescence in the public service.

The cost of money is increased by apprehension that public regulation may fix a rigid rate of earnings and not provide machinery flexible enough promptly to meet contingencies adversely affecting those earnings as they arise. This is one of the most serious complaints of the investor against utility regulation.

The cost of money is sometimes increased because the rates of return fixed by the commissions do not provide adequate margins above requirements for interest and dividends. Since those first days of war there have been many rate increases, but the lesson of those days has not been learned, and now the commissions are still endeavoring to fix the rate of return at just about the estimated or theoretical cost of money.

There is no good reason why money invested in utilities should earn less than in other industries, and, since regulation prevents excessive profits, so it should make certain the limited earnings permitted. This can be done without danger to the public by permitting a rate of return allowing a fair margin above charges representing interest on bonds and dividends on preferred stock and a reasonable dividend on common stocks, and requiring the surplus earnings to be carried as a cash reserve fund or invested in the property.

No better safeguard to the public and the investor alike can be provided than by the holding of a large part of the securities of utilities in the communities served. Local stockholders who are also customers will examine utility problems from both points of view and help in their solution.

The cost of money fixed by the law of supply and demand and the investor's appraisal of the risk is a very different thing from the rate of return fixed by the regulating authorities. The rate of return for utilities has two quite distinct but closely related functions. The most obvious purpose of the rate of return and the one most in the minds of the commissioners has been to provide and indeed to limit the earnings or compensation on the capital already invested in the utility. This the commissions can do within the limits against confiscation fixed by our constitutional provisions prohibiting the taking of property without compensation. If utilities were complete and perfect structures without change or growth and had no maturing debts, the purpose of the rate of return would be satisfied by the provision for fair return on the money invested.

The other, and in the interests of the public the more important, function of the rate of return is to provide such earnings and create such margins of protection and such confidence as will invite and attract new capital for the expansion of utilities to meet their maturing obligations and the tremendous demands upon them in these days of the growth and development of American industry.

In permanence of value, certainty of demand for product, and consistent earnings resulting from the supply of necessities in the form of

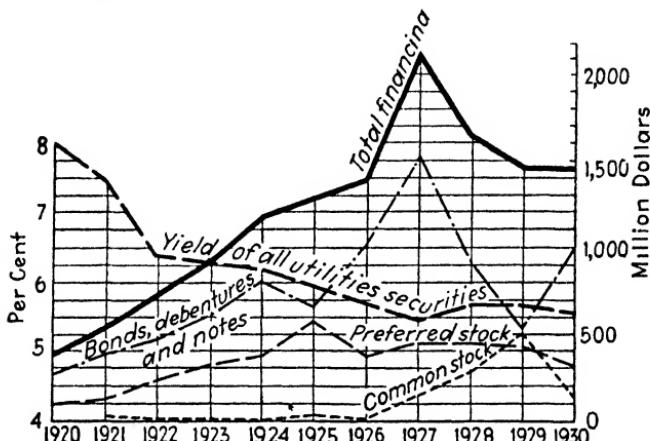


FIG. 37.—Total capitalization and yields of public utilities from 1920 to 1930.

the various kinds of public service, the securities of our utility companies should be among the premier investments of America, and the regulating authorities can place them in that position by putting into practice the principles they have recognized and enunciated in many decisions.

I personally have confidence that the sense of fairness of the American public as well as its appreciation of its self-interest will afford the remedies. The reestablishment of the credit of the vital utility industries is essential to American prosperity, and in constructive cooperation in the successful solution of this great problem utility operators and the competent authorities will earn and receive approval and applause.

The steadily downward trend in yield upon public utility investments from the year 1920 to the year of the panic, and the effect immediately thereafter, together with the varying ratios of bonds, debentures, notes, and preferred and common stocks which made up the total financing of the two billions of public utility capitalization during that period are well exemplified in Fig. 37,³ while Fig. 38* brings some of these values up to 1936.

* *Elec. World*, Jan. 2, 1937.

Although the variations of market values of stocks and bonds and therefore the corresponding variations of yields upon the actual cash investment therein may vary sharply from day to day for no good and apparent reason, as indicated, for example, in Figs. 4 and 5, Chap. IV, yet such relative values of stocks of fifty carefully selected industrial corporations, as contrasted with those of twenty public utilities and twenty railroads, may be studied to advantage. Corresponding ranges of the bonds of similar groups of corporations with respect to one another and as compared with

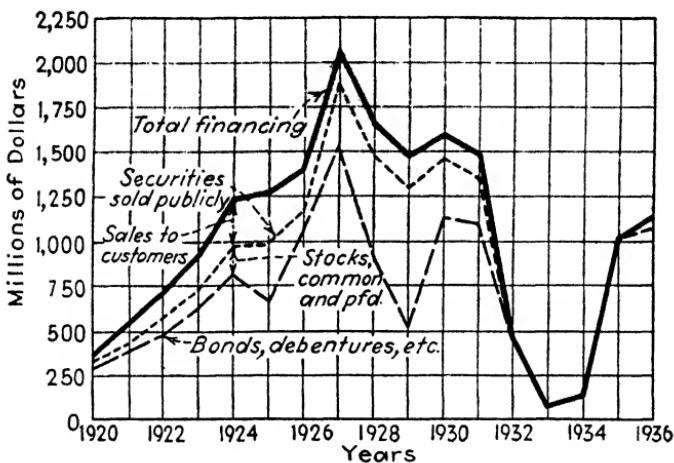


FIG. 38.—Financing of electric light and power companies 1920 to 1937.

U. S. government bonds are worthy of study in Fig. 5, Chap. IV, for the year 1934.⁴

The following quotations from Moody's Public Utilities are self-explanatory and indicate the valuable comparative ratios therein available.

Moody's Financial and Operating Ratios.

In order to meet the growing demand of investors for scientific aids to security analysis, we are publishing in this edition of the manual Income Account and Balance Sheet ratios for about 250 representative industrial corporations. It is our hope that this exhibit, used in conjunction with the material heretofore available in the manual, will prove of value to investors and students of investment problems.

While many interesting financial and operating ratios have been discovered by research, they are not all of equal importance to the investor.

In order, therefore, to simplify his task, we have, as a result of a great deal of experimentation, selected from this mass of analytical data a relatively small but very important group of ratios. We find these to be most essential to a proper appraisal of the position of a company, its past performance, and its possibilities in the capital markets.

Market Price ÷ Earnings per Share Common—Annual High and Low.—The “price-to-earnings” ratio is widely discussed, and is the subject of much difference of opinion. Formerly arbitrary values, such as 10:1, were assumed as the appropriate relation between market price and earnings per share. Later, when it was noted that certain stocks achieved and maintained higher price-to-earnings ratios, some observers abandoned the older theory of valuation, while others insisted that the stocks in question were priced too high.

In arriving at a 10:1 standard for price-earnings ratios, the following reasons have been advanced. Because of the greater risks involved, a common stock should yield more than a high-grade bond. More specifically, it is assumed that the yield should be 6 per cent to be attractive to the conservative investor. Furthermore, the better companies do not disburse all of their earnings to stockholders, but instead are assumed to distribute about 60 per cent as dividends. Therefore, to obtain a 6 per cent yield, assuming the “normal” relation between dividends and earnings, the earnings per share should be 10 per cent of the market price.

While the above theory is undoubtedly conservative, it rests on the assumption that 6 per cent represents a “normal” return on common stocks. However, even for bonds of the highest grade, whose yields to maturity are uniformly adjusted to current or prospective money rates, no one would venture to prescribe a standard rate of return, valid in all years and under all circumstances. Yet the factors affecting prices of the highest grade bonds are relatively simple, in comparison with the numerous and rapidly changing influences which determine stock prices.

On theoretical grounds, it is evidently improbable that there is any “normal” price-earnings ratio, properly applicable to every stock in every year. Wide variations in the general level of stock prices occur as the result of changes in money rates, in the amount of capital available for investment, in the ratio of loans to investments, in the general business outlook, and in the psychological attitude of the investing public.

Furthermore, there are large differences between individual companies in such important particulars as ability of management, financial strength, leadership in their respective industries, and prospective growth of the industry. Also, some companies are much more conservative than others in charges to reserves, with the result that reported net earnings of different companies are not always strictly comparable.

Instead of seeking a general formula, it is much more practical to examine the actual behavior of price-earnings ratios for a large number of individual companies. These certainly show little conformity to any general rule, although it is interesting to note that the annual *lows* for a given company usually tend to be more consistent over a period of years than the annual *highs*.

Also it is true in most cases that the price-earnings ratio covers a wide range during a single year. This is probably due in large part to the practical difficulty of accurately forecasting earnings. Preliminary ideas are frequently wide of the mark, and often result in prices which are poorly adjusted to the actual per share earnings finally reported.

Consistently high ratios are usually associated with companies showing a pronounced tendency toward steadily increasing earnings, or having unusual future prospects, for in such cases there is an expectation of rising dividends over a period of years. A reflection of this on the price-earnings ratio is natural for, after all, it is essentially a measure of investment demand.

The most extreme cases of high ratios, however, usually appear in depression years. Then abnormal declines in earnings frequently occur, and under such conditions the current year's earnings are not generally accepted as a proper basis for market valuation.

Conversely, it is entirely logical to find relatively low ratios, often well below the 10:1 level, in industries which either lack prospects of growth or are especially subject to wide cyclical fluctuations in earnings. After a poor year, the market price often is tardy in reflecting sharp improvement in earnings, because of doubt as to continued betterment.

In order that comparisons between companies may be on as uniform a basis as possible, the price range during the calendar year is used in all cases. When the fiscal year covers a different period, the price-earnings ratios are necessarily only approximate. In years where there is a stock split or stock dividend of 10 per cent or more, the prices and earnings are adjusted to the same per-share basis before computing the ratios.

Per Cent Cash Dividend Yield on Common—Annual High and Low.—Yields are affected by the factors which determine price-earnings ratios, and also by the policy of the company with respect to the disbursement of a relatively small or large percentage of its earnings in dividends. Only cash dividends are considered in computing the annual range of the yield, since there is no basis for definitely valuing the return from stock dividends. Both the price ranges and the cash dividends per share are computed on a calendar year basis. Dividends payable in January are treated as belonging to the calendar year to which they are charged in the company's income statements, which usually means the year prior to that in which they are actually paid.

Per Cent Common Dividends to Earnings on Common.—This ratio shows what part of the net earnings on common is paid to the stockholder in dividends. Generally, a low ratio under this head offsets a low yield, since it indicates that a large part of the earnings is being reinvested in the business, with a probable resulting expansion of earning power. The margin of coverage is also useful in appraising the safety of the dividend during poor years.

The relation of current assets to current liabilities, described in the following paragraph, is often an influential factor in determining the dividend policy of a corporation.

Current Assets ÷ Current Liabilities.—This ratio indicates the margin by which the current claims of outside creditors (Accounts Payable, Notes Payable, etc.) are covered by assets such as Cash or items readily convertible into Cash (Merchandise, Accounts Receivable, Notes Receivable, etc.). A low ratio is unfavorable, since a business which cannot pay its debts promptly is less able to withstand adverse conditions.

Per Cent Inventories to Total Current Assets.—If too large a proportion of the current assets consists of inventories, this impairs satisfactory showing in the working capital ratio in case the latter does not greatly exceed the required minimum. A forced sale of goods to meet current claims is likely to result in heavy losses. However, when Current Assets are considerably larger than Current Liabilities, a high ratio of Inventories to Current Assets cannot be regarded as especially unfavorable.

Sales ÷ Inventories.—The ratio of Sales to Inventories shows how many times a year the merchandise is turned over. A high or increasing ratio is favorable, since it shows that inventories are not being enlarged more rapidly than is warranted by the growth of the business.

Strictly, the value of the Inventories, which usually represents the cost of the unsold goods, should be related to total cost of goods rather than to Sales. But although such a ratio is not available from published data, the sales-to-inventories ratio is a satisfactory index of trend.

Sales ÷ Receivables.—The ratio of Sales to Receivables shows how many times a year the Accounts and Notes Receivable are turned over. A high ratio is favorable, since it indicates efficient collection and resulting minimizing of losses through bad debts. Companies cannot be fairly compared under this head when they differ widely in their types of customers or in the relative proportions of cash sales and sales on credit. Often this ratio lacks much definite significance, and for that reason it is omitted in a large proportion of cases.

Per Cent Operating Net Income to Sales.—This ratio, also commonly described as the "margin of profit," shows what part of the operating revenue is left after all operating expenses have been met. It is a meas-

ure of operating efficiency, and a relatively high or increasing ratio is a favorable indication, especially if accompanied by increasing sales.

Too literal a comparison between different companies should not be attempted in the case of this ratio, because of varying accounting methods in arriving at "operating net income." For the sake of uniformity, we have, so far as possible, taken operating net after depreciation charges, but before federal taxes.

Per Cent Sales to Net Plant Value.—A high or increasing ratio of Sales to Net Plant Value is favorable since it indicates that the plant investment is productive and justified by the volume or growth of business. A persistently declining trend is usually a bad sign, but, in cases where plant expansion has been especially rapid, must be judged partly in the light of the management's reputation for ultimate success and by the promise of the industry as a whole. This ratio differs widely between various industries, since it depends a great deal on the nature of the products.

Since Net Plant Value represents cost of plant less accrued depreciation, it is evident that liberal depreciation charges tend to increase this ratio. Therefore, high and increasing ratios for a particular company may point to more than average deductions from earnings in the Income Statements.

Per Cent Operating Net Income to Net Plant Value.—Sales are not reported by many companies, and in such cases the preceding ratio is not available. The ratio of Operating Net Income to Net Plant Value is the next best measure of plant productivity, although it is influenced by variations in the profit margin, which is also an unknown factor in the absence of sales data.

Sales ÷ Average Number of Stores.—In the case of chain stores, the volume of annual business per store is a great deal more significant than Per Cent Sales to Net Plant Value. A declining trend is due partly to competition between chains, partly to expansion into less populous localities, and partly to voluntary replacement of older stores by more numerous and smaller stores.

Per Cent Annual Depreciation Charges to Cost of Plant.—Most companies use the "straight-line" method of computing depreciation, i.e., they charge off each year a fairly constant percentage of the cost of plant. Therefore, the ratio of each year's depreciation charges to the cost of plant is given in the tables.

This relation is only a rough measure, for several reasons. The ratio is based on total plant, since further detail is not shown in many balance sheets. However, certain types of property, such as Land, are not subject to depreciation, and the proportion of these items to the total cost of property varies widely between different companies. If exceptionally

liberal charges to repairs and maintenance are made, depreciation charges may be legitimately reduced. Unusually heavy depreciation charges in the past may sometimes justify more moderate current deductions.

Between different industries, there are also wide differences in the appropriate rates of depreciation. The factor of obsolescence is much greater in some cases than in others. Depletion also has to be taken into consideration in such industries as petroleum and mining. In fact, the appropriate depletion charges for copper and other metal-mining companies are so important in determining true costs, and at the same time are necessarily so loose an estimate, that no ratio analysis has been attempted for these groups.

Per Cent Net Earnings to Net Worth.—This is possibly the most important single ratio, as it is the best direct measure of the real earning power of a company. It is the relation of the stockholders' share of the income (or the earnings available for dividends) to the stockholders' capital or net worth. The amount of net worth is the sum of the carrying value of issued stock and the amount of surplus and surplus reserves. In case "minority interest" items appear in the Balance Sheet and Income Statement, these are included in computing Net Worth and Net Earnings.

Evidently the growth in earning power of a company cannot be measured simply by the trend of annual earnings. Suppose two companies have each doubled their net earnings in a given period. The first company may have accomplished this with a relatively smaller increase in net worth, and therefore its actual earning power has increased. But the second company may have tripled its stockholders' capital while only doubling its earnings, and therefore its real earning power has declined.

It is a favorable indication when this ratio is relatively high, or is consistently increasing.

Amount of Net Earnings (in Millions of Dollars).—These figures, although not ratios, are included here so that they may be used in combination with Per Cent Net Earnings to Net Worth.

Net Earnings per Car.—For the automobile industry, the profit per unit manufactured is an interesting supplement to the total profit figure.

Per Cent Funded Debt to Total Assets.—Large industrial corporations often do not raise much of their capital through bond issues and other long-term mortgages. In certain industries, however, funded debt is an important factor, and in these cases the tables include the ratio of Funded Debt to Total Assets (valued at cost less accrued depreciation).

Now by referring to the following Table XXXVII, taken from Moody's Utilities of 1936, a comparison of actual and relative

earnings of a large and representative number of the various types of industrial corporations and public utilities may be analyzed throughout the predepression and depression periods as well as during the recent years of gradually improving business

TABLE XXXVII.—ANNUAL EARNINGS OF 1,178 COMPANIES
(Balance Available for Preferred and Common Dividends, Millions of Dollars)

Year	934 industrials	140 Class I railroads	70 utilities, light, power, and gas	25 utilities, telephone†	1,178 companies, total
1935	1,760‡	0.288*	286‡	148	2,193‡
1934	1,219	29.4 *	277	125	1,592
1933	795	13.8 *	294	115	1,190
1932	52*	151 *	343	139	280
1931	748	135	412	193	1,489
1930	2,075	523	423	202	3,224
1929	3,766	897	414	217	5,295
1928	3,194	787	366	191	4,538
1927	2,609	673	315	166	3,762
1926	2,769	809	275	155	4,008

* Deficit.

† Bell System earnings.

‡ Partly estimated.

conditions. For example, the gradual decrease in electric-railroad earnings throughout the entire period is characteristic of the lesser patronage and the ultimate elimination of many inter-urban railroads, while the electric light and power utilities increased earnings consistently from 1926 to 1930, whence after a minimum return in 1934 the curve rises again. The telephone utilities have had a similar cycle with their minimum occurring in 1933. Industrials, it will be noted from this table, had their very marked minimum in 1932, which in turn established a low for the total of all types of companies considered.

Translating the net returns into actual cash dividends declared on typical common stocks, according to Moody and including June of 1936, Table XXXVIII, the electric railroads showed a minimum of \$0.81 per share during the second half of 1932, from which condition they have recovered somewhat, while the electric

light and power utilities paid their minimum dividend of \$1.84 per share in June, 1935, from which condition little recovery has been enjoyed. The minimum for industrials was \$0.72 per share in June, 1932, with a recovery to double that dividend in June, 1936. The total, including banks and insurance companies, reached its low in June, 1933, at which time it was less than half the 1929 value and only about two-thirds its present (1936) return. Thus the trends of this particularly severe business cycle may easily be followed from data readily available.

TABLE XXXVIII.—DIVIDEND INDEX, WEIGHTED AVERAGE PER SHARE
(Cash Dividends on 600 Common Stocks)

	June 30, 1936	Dec. 31, 1935	June 30, 1935	Dec. 31, 1934	June 30, 1934	Dec. 31, 1933	June 30, 1933	Dec. 31, 1932	Dec. 31, 1931	Dec. 31, 1930	Dec. 31, 1929
492 industrials.....	\$1.41	\$1.26	\$1.10	\$1.06	\$0.95	\$0.83	\$0.72	\$0.89	\$1.55	\$2.24	\$2.72
36 rails.....	1.21	1.21	1.24	1.21	1.09	0.91	0.86	0.81	2.80	6.17	6.14
30 utilities.....	1.86	1.86	1.84	1.90	1.97	2.07	2.19	2.31	2.84	3.03	2.62
21 banks.....	3.00	2.98	3.19	3.73	3.60	3.61	3.55	4.37	5.84	5.94	5.90
21 insurance.....	2.03	2.37	2.17	1.78	1.70	1.67	1.66	1.89	3.00	3.58	3.50
600 total.....	\$1.51	\$1.41	\$1.29	\$1.27	\$1.19	\$1.11	\$1.05	\$1.21	\$1.96	\$2.73	\$3.03

This table gives the weighted average-per-share rate of common cash dividends. The aggregate annual amount of dividends in effect at any given date is computed, and this is divided by the total number of common shares outstanding on that date (after making necessary adjustments in number of shares to offset the effect of stock dividends and stock splits).

Referring now to the report of the yield on typical public utility bonds, Table XXXIX shows a significant decrease from 1922 to 1928, followed by a favorable reaction during the first years of the depression, reaching a maximum in 1932, after which a gradual recession in yield has taken place to date (1936). Note, therefore, a distinctly different trend in the long-term security yields during the depression periods as contrasted with stocks.⁵

In considering net yields to the investor, however, he must take into consideration the results of the necessary subtraction of the income tax, which has been a constantly increasing obligation during recent years and which has materially decreased actual net yields to the bond and share holder.

TABLE XXXIX.—AVERAGE YIELD ON DOMESTIC UTILITY BONDS

Year	Average for year	Year	Average for year
1922	5.93	1930	5.05
1923	5.84	1931	5.27
1924	5.61	1932	6.30
1925	5.29	1933	6.25
1926	5.11	1934	5.4
1927	4.96	1935	4.53
1928	4.87	1936	4.26 for 6 mos.
1929	5.14		

This table gives the average yield on forty domestic utility bonds (twenty prior to 1928). All yields are calculated to maturity dates. When it is necessary to remove a bond from the list used, due to a change in the rating or to some other cause, another bond is substituted and the average is properly adjusted. Thus at all times the yield averages are comparable as between different periods.⁵

Although it is difficult to predict what this obligation is likely to be in the future—and with something akin to apology for introducing such a controversial and variable factor into a textbook—yet it is believed that the young engineer and prospective investor (are they ever synonomous?) should be forewarned of this reduction in yield which he is all too prone to neglect.

Although the general subject of taxation is too broad, too involved, and in too much of a state of transition at present to warrant detailed discussion in such a textbook, the effect of taxation upon income should be at least suggested for study by the prospective investor or company executive.

The statements of Moody's Public Utilities and Moody's Industrials have already been quoted to indicate more or less standard practice regarding the shrinkage of net income due to taxes from the apparent return from stocks and bonds.

However, the much-feared reaction from the application of the Federal Revenue Act of 1936 should be given further attention. The increases in public utility taxes from 1902 to 1936 are indicated in Table XL.*

* *Elec. World*, Jan. 2, 1937.

To secure the permanent revenue considered to be necessary for the federal government, a tax on undistributed earnings of corporations was proposed by the President as a substitution for the net-income, excess-profits, and capital-stock taxes. After many counterproposals and much discussion in both houses of Congress, the compromise measure of 1936 contained a graduated tax on corporation net income, a graduated tax on undistributed

TABLE XL.—REVENUE AND TAXES; COMMERCIAL COMPANIES ONLY
(Compiled by Edison Electric Institute)

Year	Gross operating revenue* (thousands of dollars)	Taxes (thousands of dollars)	Ratio of taxes to revenue, per cent
1902	77,132	2,655	3.44
1907	156,447	6,346	4.06
1912	268,360	13,117	4.89
1917	464,881	29,897	6.43
1922	883,334	73,128	8.28
1927	1,588,908	150,253	9.46
1932	1,737,973	203,858	11.73
1933†	1,654,766	206,989	12.5
1934†	1,695,521	239,773	14.1
1935†	1,798,000	251,158	14.0
1936‡	1,938,000	272,258	14.0

Data from U. S. Census, except last four years.

* Includes revenue from ultimate consumers, from sales to municipal plants for "resale" and miscellaneous operating expenses, but not sales for resale to other light and power companies.

† From F.P.C. Rate Series No. 5, "Base Revenue," excluding sales for resale.

‡ Estimated on ten months' operations, *Electrical World*.

earnings, excess-profits tax, capital-stock tax, and windfall tax. Corporation dividends paid to individuals were made subject to the normal individual income tax.

The following excerpt from the Senate Report of the 74th Congress sets forth some of the abuses of the present taxation income procedure which the proposed enactment was expected to neutralize.⁶

Extended study of methods of improving present taxes on income from business warrants the consideration of changes to provide a fairer distribution of the tax load among all of the beneficial owners of business

profits whether derived from unincorporated enterprises or from incorporated businesses and whether distributed to the real owners as earned or withheld from them. The existing difference between corporate taxes and those imposed on owners of unincorporated businesses renders incorporation of small businesses difficult or impossible.

The accumulation of surplus in corporations controlled by taxpayers of large incomes is encouraged by the present freedom of undistributed corporate income from surtaxes. Since stockholders are the beneficial owners of both distributed and undistributed corporate income, the aim, as a matter of fundamental equity, should be to seek equality of tax burden on all corporate income whether distributed or withheld from the beneficial owners. As the law now stands (i.e., before the passage of the 1936 enactment), our corporate taxes dip too deeply into the shares of corporate earnings going to stockholders who need the disbursement of dividends, while the shares of stockholders who can afford to leave earnings undistributed escape current surtaxes altogether.

The method of evading existing surtaxes constitutes a problem as old as the income-tax law itself. Repeated attempts by the Congress to prevent this form of evasion have not been successful. The evil has been a growing one. It has now reached disturbing proportions from the standpoint of the inequality it represents and of its serious effect on the federal revenue. Thus the Treasury estimates that, during the calendar year 1936, over \$4,500,000,000 of corporate income will be withheld from stockholders. If this undistributed income were distributed, it would be added to the income of stockholders and there taxed as is other personal income. But, as matters now stand (i.e., before the passage of the 1936 enactment), it will be withheld from stockholders by those in control of these corporations. In one year alone, the government will be deprived of revenues amounting to over \$1,300,000,000.

A proper tax on corporate income (including dividends from other corporations), which is not distributed as earned, would correct the serious twofold inequality in our taxes on business profits if accompanied by a repeal of the present corporate income tax, the capital-stock tax, the related excess-profits tax, and the present exemption of dividends from the normal tax on individual incomes. The rate on undistributed corporate income should be graduated and so fixed as to yield approximately the same revenue as would be yielded if corporate profits were distributed and taxed in the hands of stockholders.

Such a revision of our corporate taxes would effect great simplification in tax procedure, in corporate accounting, and in the understanding of the whole subject by the citizens of the nation. It would constitute distinct progress in tax reform.*

The principal objections to and criticisms of such a proposal, as reported in the discussion of the House of Representatives were as follows:

1. It will discourage and possibly prevent the accumulation of adequate rainy-day reserves and constitutes a direct threat to the security of business, employment, and investments.
2. It will cause corporations to restrict the distribution of their existing tax-paid reserves, which can only be rebuilt under penalty.
3. It will discourage business rehabilitation and expansion and have a retarding effect upon recovery and reemployment.
4. It will hamper the growth of small corporations, impede the development of new enterprises, and foster monopolies.
5. It puts a penalty on prudence and a bounty on improvidence and constitutes an unwholesome interference with the exercise of sound judgment in the management of business.
6. It will accentuate the extremes of future booms and depressions.
7. It will oppress businesses burdened with debts and will result in a restriction on corporate credit.
8. It will drive capital out of productive enterprise into tax-exempt securities.
9. It violates every sound principle of income taxation, is arbitrary and oppressive in its application, and will be unequal and discriminating in its operation.
10. It will crucify financially weak enterprises, while permitting the strong to minimize or entirely escape the tax.
11. It will create inequities and unfair competitive situations which are far greater and more real than the imaginary ones it purports to correct.
12. It will result in the double taxation of all dividends paid out of reserves, whether accumulated in the past or in the future.
13. It will cause untold confusion and add bewildering complexities both in the computation and administration of the tax.
14. It abandons an assured revenue of \$1,100,000,000 annually for one truly speculative and uncertain, and which promises to be most disappointing in amount, thereby further jeopardizing the federal revenue.⁷

As is usually the case in the face of so much criticism, the final enactment, now the law upon income taxes, is a compromise that is well summarized as follows:⁸

Most of the important changes made by the 1936 act related to the taxes on corporations. The rates of the individual income tax, estate

tax, gift tax, and the administrative provisions remain practically as they were in the Revenue Act of 1934 as amended by the Revenue Act of 1935. Unlike the latter, the act of 1936 is *not written as an amendment* to the preceding revenue *but as an entity in itself*, though it does contain many cross references to other acts. Following is a summary of the principal changes effected by the new law:

1. Although rates of the *individual* income tax remain as they were,* henceforth corporate dividends received by individuals will be subject to the normal tax, whereas heretofore they have been subject to the surtax only.
2. The graduated tax on net income of corporations was retained as a normal tax, with the rates on the lower brackets reduced.
3. A surtax was levied to apply to corporate earnings after deducting the normal tax, graduated according to the amount of undistributed income.
4. A special credit was provided for corporations with net incomes of less than \$50,000.
5. Banks, insurance companies, and companies in receivership were exempted from the surtax. Banks and insurance companies were made subject to a flat normal tax of 15 per cent; companies in receivership, to the graduated normal tax imposed upon all corporations.
6. The rates of special penalty tax imposed on corporations formed for the purpose of preventing the imposition of the surtax upon its shareholders were reduced by 10 per cent in the case of corporations subject to the undistributed earnings tax. In the case of those corporations, such as banks, foreign corporations, etc., which are not subject to the undistributed profits tax, the penalty is not reduced but is the same as the tax under the preceding act.
7. The rates of surtax on undistributed net income of personal holding companies were reduced 12 per cent on each bracket.
8. Fifteen per cent of intercorporate dividends were made taxable in contrast to 10 per cent in the previous law.
9. An important change made by the new act was to permit a parent corporation to liquidate a subsidiary corporation without recognition of gain or loss, and to require the parent corporation to take as its basis for computing gain or loss, depreciation or depletion, the basis which the assets had in the hands of the subsidiary corporation.

* The normal tax on individual incomes is 4 per cent. Surtax rates begin with 4 per cent upon the \$4,000 to \$6,000 bracket and are graduated until they reach 75 per cent upon the excess above \$5,000,000. Personal credits are: for a single individual, \$1,000; for husband and wife, \$2,500; for each dependent, \$400. A credit of 10 per cent of the amount of earned income is allowed also. For this purpose, all income up to \$3,000 but no more than \$14,000 is considered earned.

TABLE XLI.—COMPARISON OF CORPORATION TAX RATES, 1935 AND 1936
ACTS^a

Normal tax on net income	Act of 1935, per cent	Act of 1936, per cent
Up to \$2,000.....	12.5	8.0
\$ 2,000 to 15,000.....	13.0	11.0
15,000 to 40,000.....	14.0	13.0
Above \$40,000.....	15.0	15.0
Surtax on undistributed net income; percentage of adjusted net income:		
0 to 10 per cent.....	....	7.0
10 to 20 per cent.....	....	12.0
20 to 40 per cent.....	....	17.0
40 to 60 per cent.....	....	22.0
Above 60 per cent.....	....	27.0
Excess-profit tax; net income as per cent of declared value of capital stock:		
10 to 15 per cent.....	6.0	6.0
Above 15 per cent.....	12.0	12.0
Capital-stock tax.....	0.14	0.10
Personal holding-company penalty tax; undis- tributed net income:		
Up to \$2,000.....	20.0	8.0
\$ 2,000 to 100,000.....	30.0	18.0
100,000 to 500,000.....	40.0	28.0
500,000 to 1,000,000.....	50.0	38.0
Above \$1,000,000.....	60.0	48.0
Penalty surtax on corporations improperly accumulating surplus; amount of retained income:		
Up to \$100,000.....	25.0	15.0*
Above \$100,000.....	35.0	25.0*

* In cases of corporations not subject to surtax on undistributed profits (for example, banks and insurance companies), the rates are 25 per cent and 35 per cent.

Miscellaneous minor changes were made, 10–13 inclusive, primarily upon nonresident aliens and foreign corporations, which will not be quoted here because of their specialized interest.

14. The capital-stock tax was reduced from \$1.40 to \$1 per \$1,000.

15. A new tax of 80 per cent, the "windfall" tax, was levied on the "unjust enrichment" resulting from the invalidation of the processing tax.

The following comments⁶ of those who have made a thorough study of the probable effects of this new law will be found of value as each reader analyzes his contact therewith, either as an investor or as one who has the responsibility of developing and operating industries of various types which are likely to be markedly affected by such a tax in the future:

The Revenue Act of 1936, like most revenue acts, was a compromise of numerous compromises, and it exhibits the merits and demerits common to such compromises. By retaining the major parts of the old provisions for taxing corporations it minimizes the uncertainties of administration and also of revenue yields; by adding a new kind of tax on undistributed corporate earnings at somewhat lower rates than first suggested it gives opportunity to develop administrative experience and also to test the fiscal and economic results of such a tax. On the other hand the rates of the new tax are perhaps higher than necessary for experimental purposes, possibly high enough to do much damage if the tax should prove to have serious economic effects. Moreover, the superimposing of the new tax on top of several old corporation taxes does not make for the simplicity which the President suggested; and, if long retained in its present form, the new tax will almost certainly tend to increase the fluctuations in public revenue that accompany the ups and downs of business.

The most serious objections against the corporation tax proposals, however, related to their effects upon corporate management and finances, particularly to the effects upon corporation reserves and credit. Of course, heavy payments of any kind for which equivalent value is not received affect reserves, credit, capacity to pay debts, ability to compete, and ability to employ labor. They naturally affect especially the financially weaker concerns, including beginners and older unfortunates, some of which may later make more than average contributions to society if not handicapped too much by taxes or something else. It may be that the new corporation surtax will have more unfavorable effects than fiscally equivalent increases in the previously existing taxes or some alternative measures would have had. The relief provisions of the new law are substantial, however, and they favor the corporations with the smaller incomes, those paying off debts, and others that are specially situated or that are handicapped in certain ways. These constitute the great majority of all corporations, in fact, all but

a fraction of the total number.* It is probable that attorneys of the corporations seriously affected will be able to advise their clients how to make the most of the changed situation, and we may expect reorganization and changes in dividend, reserve building, and other policies.

The extent to which this new law will affect the investor as contrasted with the corporation issuing the securities will depend upon the "tax-exemption clauses" of the bonds issued and the policy of the corporations with respect to the reduction of surplus in order to avoid the increased taxes thereon. With regard to the former, Moody's is quoted as follows:

Tax-free Clauses.*—Indentures under the terms of which corporate obligations are issued frequently contain so-called "tax-free covenant clauses," which are either limited or unlimited in scope. An unlimited tax-free covenant clause usually provides for payment by the issuer to the bondholder, on each interest date of the entire nominal amount of interest called for by the obligation without deduction for any taxes, whether federal or state, that the issuer may be required to withhold or to pay under any laws existing at the time the indenture is drawn or which may be enacted in the future. Such broad clauses, as a rule, are not included in indentures and/or bonds now being issued, but they occur frequently in obligations issued prior to the inception of the federal income tax in 1913.

Prior to the revenue act of 1918, the normal federal income tax with respect to resident taxpayers was collected at the source, and in the case of interest on corporate obligations the corporation was required to pay the amount of the tax to the government. If the indenture or the bond contained a tax-free covenant clause (applicable to federal taxes), the corporation paid the holders of its obligation the full amount of interest; otherwise a deduction was made from the interest on account of the tax paid by the corporation on behalf of each holder of its obligations. The individual normal federal income tax under the revenue acts prior to that of 1918 never exceeded 2 per cent, but with the revenue act of 1918 the normal tax rate was increased above 2 per cent and at the same time the government discontinued the general practice of collecting the tax at the source in the case of individual residents in the United States and adopted the practice of collecting the tax directly from the

* "According to estimates of Treasury officials there are some 500,000 corporations in the United States; of the 257,000 that report net income, 43,000 have incomes in excess of \$10,000 each, and 214,000 have incomes of less than \$10,000 each." 74th Congress, 2d Session, *Hearings before the Senate Finance Committee*, p. 12.

individual. Provision was made in the law, however, that if a borrower promised to pay interest without deduction for any federal taxes that it might be required to withhold the normal federal income tax, payable on the interest to resident holders, up to 2 per cent, which was the normal federal income-tax rate prior to the change in the government's practice as to collection. Without this withholding provision, which continues in effect with respect to all bonds issued prior to Jan. 1, 1934, tax-free covenant clauses in bond indentures would be inoperative. Thus, under this provision of the law, borrowers, on bonds issued prior to Jan. 1, 1934, who have agreed to pay interest without deduction of federal income tax up to 2 per cent or more without limit are required to withhold only 2 per cent.

The scope of tax-free covenant clauses now included in indentures and/or bonds is usually definitely delimited. The borrower's obligation with respect to federal income tax is usually limited to 2 per cent, and the application of the clause to state taxes is usually restricted to certain states mentioned in the clause and limited in each instance to a specified rate. Frequently the indenture will provide simply that the company will pay interest without deduction for any federal income tax that it may be required to withhold not exceeding 2 per cent.

With the Revenue Act of 1934, the government restricted the requirement that borrowers withhold normal federal income tax up to 2 per cent on tax-free covenant bonds held by residents to bonds issued prior to Jan. 1, 1934. Regardless whether bonds issued after Jan. 1, 1934, contain tax-free covenant clauses, the borrower is not required to withhold normal federal income tax in any amount on such bonds when held by residents. Thus a resident holder of a tax-free covenant bond issued on or after Jan. 1, 1934, will be required to pay the full normal federal income tax on the interest from such bond. In view of this change in the law, it is likely that bonds issued in the future will contain provisions to refund federal income tax paid by the borrower up to 2 per cent rather than tax-free covenant clauses.

Tax-free covenant clauses should not be confused with agreements on the part of borrowers to refund specific taxes. Tax-free covenant clauses are operative only with respect to taxes that are paid by the borrower on behalf of recipient of the interest; whereas tax-refund agreements apply to taxes paid directly by the recipient of the interest, which taxes the borrower may agree to refund, subject to limitations indicated in the agreement upon application within a specified time.

Furthermore, the investor must recognize the possibility of reduced yield due to inflation and to the far-reaching decision of the U. S. Supreme Court upon the so-called "gold clause," which is abstracted as follows:⁶

While practically all bonds issued in the United States are expressed to be payable, both as to principal and interest, in gold coin of the United States of America or not inferior to the standard of weight and fineness existing as of the dates of the coupon bonds of the respective issues, Public Resolution No. 10 of the Seventy-third Congress of the United States, approved June 5, 1933, declares that every provision in an obligation purporting to give the obligee the right to require payment in gold or a particular kind of coin or currency is against public policy and that every obligation theretofore or thereafter incurred, whether or not any such provision is contained therein or made with respect thereto, shall be discharged upon payment dollar for dollar in any coin or currency which, at the time of payment, is legal tender for public and private debts.

With regard to the tendency of corporations to change their policies with respect to surplus and dividends, the following abstract from *Business Week* is significant:

How They're Beating New Tax Act.⁸—Many corporations have devised ways of dodging the penalties under the 1936 law. Here are a dozen of the outstanding methods adopted.

There is a formidable dossier of ways and means to deflect the shock of the new law to stockholders who will have to pay taxes on dividends received.

A Guide for Others.—For corporations which have not brought their tax procedures to a jell, what has been done by others should prove a guide. Here are a dozen methods that have been resorted to:

1. Many companies have already made provision for the undistributed earnings tax in their six and nine months' earnings reports.
2. Optional dividends have been used—payments either in cash or stock.
3. Dividends have been paid in preferred stocks.
4. One company, by recapitalizing, has converted a profit and loss deficit into a surplus, enabling it, under state laws, to pay out 1936 earnings as a dividend.
5. Companies have paid out large dividends in cash and have resorted to new financing to rebuild working capital.
6. One company has deferred payment of a dividend to its 1937 fiscal year, because the new taxes do not apply to it this year.
7. Several companies have dissolved subsidiaries.
8. Bonuses have been paid, and profit-sharing schemes instituted.
9. Although there is no direct trace, advertising expenditures have undoubtedly been enlarged.
10. Maintenance has been increased.

11. In the securities markets, because of the capital-gains tax, many traders have held on to profits, instead of pocketing their gains and letting Uncle Sam share them.

12. All along the line, dividends have been increased—not only because of improved earnings, but also because it is a seeming tax advantage to pass earnings on to shareholders and let them pay the taxes.

But what one company has done is not a sure-shot prescription for another company. There is no rule-of-thumb escape. Each company must decide for itself its own tax policy. There are all sorts of nice distinctions. For example, Chrysler, in the first half, set aside reserves for paying the tax; General Motors did not. Likewise, Montgomery Ward did; Sears, Roebuck did not.

Yet Sears has met the problem in its own way. Directors this week voted an extra dividend of \$1.75 a share in cash, payable Dec. 15, and expect to pay a similar amount before the close of the company's fiscal year, Jan. 31. In addition there will be a \$1,500,000 distribution to employees as a special "jubilee" wage bonus. In order to reimburse the company for these outlays and to bolster the working capital position, Sears plans to issue common stock to raise \$35,000,000.

Yellow Truck & Coach, with estimated earnings of \$4,500,000, hit on the scheme of recapitalizing so as to show a balance-sheet surplus instead of a deficit, which, under state laws, inhibited dividends. Now, having a statistical surplus, the company can legally pay out earnings to preferred stockholders and dodge the surtax. But to replenish the till and get funds for expansion, new common stock is to be offered.

Less spectacular but just as effective were the plans adopted by Caterpillar Tractor, which has offered stockholders an optional cash or preferred-stock dividend (BW—Oct. 24 '36, p. 31); by Chesapeake & Ohio, which has scheduled extra dividends of \$1 in cash and \$2 in new 4 per cent noncumulative preferred stock, and by Greyhound Corp., which intends to pay an extra of \$3 a share in new 5½ per cent convertible preferred.

Stockholders of General Foods Corp. are likely to receive five dividends this year instead of the customary four (the same goes for Sears, Roebuck). C. M. Chester, chairman of the board, said that at a meeting toward the end of the year, directors would take further dividend action. Simmons Co. similarly expects to vote on another dividend when directors obtain a better idea of earnings—this in addition to upping the quarterly recently from 50 to 75 cts. a share.

A few companies, like Texas Gulf Sulphur and Mathieson Alkali, are taking the undistributed earnings tax in their stride—presumably because it is expected that dividends will work out to the equivalent of earnings. Hence, Texas Gulf adds this complacent note to its nine

months' report to stockholders: "As it is expected that no surtax on this company's undistributed profits will be due under the Revenue Act of 1936, no deductions therefor are reflected."

Investment trusts, which desire to qualify as "mutual investment companies," have been busy computing stock-market profits, so as to distribute them to stockholders and thereby avoid income taxes. Most notable declaration of intention came from State Street Investment Corp., which plans to pay \$20 a share (BW—Oct. 17 '36, p. 50). In effect, this is a capital distribution. To enable stockholders to keep their stake in the company (and incidentally to reupholster the assets of the trust) treasury shares will be offered for subscription to recipients of the dividend.

The undistributed earnings tax has been the basis for a law suit. A group of stockholders of the Standard Fruit & Steamship Corp. have gone to court to compel directors to pay accumulated dividends on the company's preferred shares. Among other reasons adduced for the distribution was the high tax the company would have if the earnings were retained.

Three companies—General Motors, Champion Fibre, and Carrier Corp.—have dissolved subsidiaries. This eliminates the tax on inter-corporate dividends; at the same time simplification of corporate structures results.

But on the whole, the law has not resulted in simplification. Rather, it has added to complexity. When companies increase their capital stock (either to replenish cash positions, or, when they issue new preferred, to pay dividends) there is an expansion in the capital account. This complicates financial structures. It is prompted by a law, rather than business. During a period of increasing business activity, this enlargement of the capital account is supportable; but in depression it is bound to find reflection in thin earnings, available for common shares. Today it is a boon; but today's boon may be tomorrow's boomerang.

Pennsylvania Railroad (and probably more than one other road) has eased its tax problem by increasing maintenance of way and structures. This has the effect of plowing back receipts into property without raising tax liability.

Bonus plans—adopted by Sears, National Cash Register—and profit-sharing plans, such as those of Westinghouse Electric and Keystone Steel & Wire (BW—Aug. 8 '36, p. 12; Sep. 5 '36, p. 24) cut down the burden, and as Christmas approaches there will be more announcements of this type.

Honor for pulling a neat trick goes to Servel, Inc. Its fiscal year ends Oct. 31, and taxes for the present fiscal year will be paid under the old law, so that the company does not have to worry about the surtax.

Therefore, to crowd dividend payments into the next fiscal year, when they will apply against the surtax, Servel directors deferred voting on the next dividend until Nov. 5—after this fiscal year has closed. Which will cut down the surtax when the 1937 tax bill rolls around. In a similar category (but with a different twist) is Hecla Mining (BW—Aug. 22 '36, p. 26). It decided that the fourth quarter dividend, normally payable on Nov. 15, would be postponed to enable directors "to make an intelligent estimate of 1936 earnings and to gauge the effect of the tax."

In the group of intangibles—means to escape the tax for which there are no concrete data—there is advertising. Appropriations this year have gone up. The size of magazines, the scarcity of radio time, the statistics on expenditures, all record the upturn.

In the category of intangibles also comes bought-insurance, in lieu of self-insurance (BW—Aug. 1 '36, p. 35). Moreover, at least one small company is known to have rented office equipment instead of buying it. Rentals represent an expense, chargeable against income. If equipment had been purchased outright, the company would be allowed to charge off depreciation; but leasing eliminates a lot of bookkeeping.

The philosophy behind the adoption of means to lighten the tax burden is fairly clear: to take it as a one-year affair and get it over with. The theory is that it is unworkable, that it causes an overexpansion of capital if companies are to pay out all (or nearly all) earnings and yet keep on hand sufficient working funds.

In the last analysis, business is carried on for the profit it will yield. The term "yield," used as a noun, is indefinite and is variously interpreted. It might refer to gross revenue, net income, interest, or dividends declared by directors to stockholders. It is usually considered, however, by the investor as the annual return to him in dollars or as a percentage of his investment.

In Chap. XII several forms of capitalization were considered which resulted in various yields to bondholders, preferred stockholders, and common stockholders. Such yields, from manufacturing and merchandising corporations, are likely to vary widely from year to year depending upon the conditions of business. Large yields, in prosperous years may, therefore, more than make up, in the opinion of the investor, for the decreases in or entire elimination of such returns in periods of depression. Furthermore, aside from the contractual obligations of a corporation to pay certain bond interest upon its bonded indebtedness and a

prescribed preferred-stock dividend, the directors of the corporation alone determine the amount that shall be paid by the corporation to its common stockholders from the profits or surplus of the year's transactions. The only recourse of the common stockholders, as explained more in detail in Chaps. III and IV, providing the directors are not acting illegally, is to elect new directors, as their terms expire, who will have more generous policies toward the common stockholders.

The following court decisions illustrate the rights and obligations of directors to pay, or not to pay, possible dividends to the stockholders of the corporation they represent:^{*}

"The apportionment of net earnings to the payment of cash dividends, stock dividends, increase of capital, reserve for contingent fund, or to provide for future obligations is largely one of policy, intrusted to the discretion of the directors, which, when honestly and intelligently exercised, will not be lightly overruled."⁹

Nor is it always necessary to limit the dividends to the profits of the particular year in which the dividends are paid, if there has been an adequate surplus accumulated from profits of previous years. In fact, it is frequently considered good business policy, maintaining thereby the credit of the corporation and the values of its stocks upon the market, if a *moderate and constant* dividend yield can be held for a period of years.

In the decision of *Maughan v. State*, the court ruled: "Dividends may be paid from the surplus which may have accumulated from the profits of previous years, although there may have been no actual profits during the year in which such dividends are declared and paid. . . . There must be a surplus previously accumulated or made during the current year. . . ."¹⁰

In the case of *William v. Western Union Company*, it was ruled:

The company had made surplus earnings which it could have divided, but instead of dividing them it had invested them in property to facilitate and enlarge its business; and such property was found to be worth \$15,526,590. That sum constituted its surplus. It was commingled with other property of the company and used for corporate purposes. But it was not beyond the reach of the dividend-making power of the directors. They could reclaim it for division among the stockholders, and, if practicable, convert it into cash for that purpose.¹¹

* See also Chap. V, Functions of the Board of Directors.

However, in cases where profits have been earned and, particularly, where a large surplus exists without any definite plan for its use and when the directors fraudulently refuse or neglect to pay a dividend, a *court of equity** will compel them to do so.

When a business of a trading corporation has by successful management been brought to a condition of financial prosperity, in which the profit, after the payment of all indebtedness, is more than twenty times the amount of the original capital, a reasonable share of the net earnings should be applied to the payment of stock dividends, though a part be reserved to enlarge the business itself. In the present case, there was no proof of any honest purpose to enlarge the business of the company, the withholding of the dividends being a mere pretext for an opportunity to absorb the profits by fraudulent devices.¹²

In the most prominent case, which attracted a great deal of attention a few years ago, in which the minority stockholders of the Ford Motor Company forced the payment of a dividend of \$19,000,000 through court action, the court argued as follows:

(1) A business corporation is organized primarily for the benefit of its stockholders, and the discretion of directors does not allow them to withhold profits merely for the benefit of the public; (2) therefore, it is equitable to require payment of a \$19,000,000 dividend where a corporation has on hand \$54,000,000 in cash, has a constant net income of over \$60,000,000 per annum, can only show a need for \$24,000,000 for extensions and improvements, and has a surplus of \$112,000,000.^{13,14}

In the case of bondholders and preferred stockholders, a definite contract is recognized between the corporation and the holder of the respective bond or stock certificate; these state the obligations of the corporation.

In one typical case, in which the court required the fulfillment of such a contract with a preferred stockholder, the ruling stated:

The conditions under which the holder of preferred stock may demand a dividend depend, of course, upon the precise terms upon which it is issued.

The fair interpretation of the contract between the corporation and the holder of this stock is that, if in any year net profits are earned, a dividend is to be declared. To hold that the board of directors . . . has a discretion to declare or not to declare a dividend when it has funds that it can use for the purpose, is to hold that one of the parties to a contract

* See HARDING and CANFIELD, "Legal and Ethical Phases of Engineering," for functions of courts of equity.

TABLE XLII.—FINANCIAL RATIOS, GENERAL ELECTRIC COMPANY
Electrical Equipment

TABLE XLIII.—FINANCIAL RATIOS, AMERICAN MACHINE & FOUNDRY COMPANY
Machinery and Tools

Year	Market price + earnings per common share		% cash divi- dend yield on common stock		% com- mon divi- dend to earnings		Current assets + current liabili- ties		% of inven- tory to current assets		Sales + receiv- ables		% of oper- ating net to sales		% annual de- precia- tion to plant cost		% net earnings to net worth		% oper- ating net income to net plant value	
	High	Low	High	Low																
1934	21.28	11.15	8.1	4.2	87.6	9.11	30.1	3.00	6.24	8.8	..	..	2.6	6.7*	1.1	15.4	..	..	..	..
1933	31.08	12.16	9.1	3.6	108.2	11.88	23.9	2.72	5.78	2.2	..	..	2.2	3.8	0.7	2.6	..	..	..	..
1932	19.87	6.70	13.3	4.5	95.3	16.86	21.9	2.88	5.99	10.2	..	..	2.6	5.6	1.1	13.0	..	..	..	..
1931	26.58	9.36	8.8	3.2	78.0	6.00	15.3	6.86	7.45	15.4	..	..	3.6	8.7	1.7	34.4	..	..	..	..
1930	19.84	10.51	5.5	2.9	55.0	14.57	21.9	6.28	13.28	21.7	..	..	4.3	16.3	2.9	66.7	..	..	..	..
1929	23.12	11.74	4.9	2.5	57.4	10.65	27.8	4.11	9.84	16.9	..	..	4.1	12.6	2.6	50.8	..	..	..	..
1928	27.44	19.74	3.9	2.8	75.5	14.01	27.9	3.06	8.01	6.8	..	..	5.3	7.2	1.4	17.0	..	..	..	..
1927	26.51	10.30	2.7	1.1	21.2	13.26	43.5	3.04	8.01	13.6	..	..	5.1	8.2	1.4	40.5	..	..	..	..
1926	21.18	17.17	0.0	0.0	0.0	9.81	68.1	2.19	7.64	9.4	..	..	4.5	4.5	0.8	25.0	..	..	..	..

* Capital surplus of \$2,357,778 eliminated by write-down investment in stock of International Cigar Machinery Company.

TABLE XLIV.—FINANCIAL RATIOS, SEARS, ROEBUCK & COMPANY
Retail—Mail Order

Year	Market price + earnings per common share		% cash dividend yield on common stock		% common dividend to earnings on common		Current assets + current liabilities		% inventory to current assets		Sales + receivable		% of operating net sales to sales		% annual depreciation to plant cost		% sales to net plant value		% net earnings to net worth		Net earnings (in millions of dollars)	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
1934	16.37*	9.90*	0.0	0.0	0.0	0.0	3.20	65.0	4.72	12.83	6.2	..	..	..	..	..	..	8.1	15.0	..	..
1933	20.00	5.32	0.0	0.0	d	3.3	2.29	67.5	3.73	14.29	5.9	..	..	..	..	..	..	6.1	11.2	..	..
1932	d	12.7	3.3	d	12.25	8.3	4.0	99.5	4.65	5.52	13.49	d	..	..	..	..	..	..	d	d	..	..
1931	25.61	12.25	8.3	4.0	33.43	14.33	5.8	2.5	80.6	3.79	48.1	6.08	10.79	4.0	..	..	..	..	6.0	12.2	..	..
1930	27.34	12.08	3.1	1.4	31.45	13.08	3.0	1.3	39.1	3.24	60.2	5.91	14.07	5.6	..	..	..	..	7.1	14.3	..	..
1929	15.35	8.66	4.1	2.7	15.35	8.66	5.1	3.7	42.0	4.77	48.9	5.59	22.04	10.2	..	..	..	..	15.5	30.1	..	..
1928	11.59	8.43	5.1	3.7	11.59	8.43	5.1	3.7	43.1	5.26	44.5	6.07	25.62	11.1	..	..	..	..	15.3	25.0	..	..
1927	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	14.1	21.9	..	..
1926	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

* Prices for calendar year; earnings for fiscal year ended Jan. 31, 1935.

d Deficit.

TABLE XLV.—FINANCIAL RATIOS, UNITED STATES STEEL CORPORATION

Year	Market price + earnings per common share		% cash dividend yield on common stock	% common dividend to earnings on common	Current assets + current liabilities	% of inventory to current assets	Sales + receivable	% sales to net plant value	% annual depreciation to plant cost	Net earnings (in millions of dollars)	% of funded debt to total assets
	High	Low	High	Low							
1934	d	d	0.0	0.0	d	7.50	61.2	2.30	16.06	d	5.4
1933	d	d	0.0	0.0	d	7.75	62.3	2.08	11.76	d	5.2
1932	d	d	0.0	0.0	d	8.46	66.0	1.38	13.57	d	5.3
1931	d	d	15.3	3.6	d	7.74	61.2	2.41	18.14	d	5.2
1930	21.82	14.75	5.2	3.5	76.2	5.31	56.9	3.66	21.12	10.8	104.4
1929	12.35	7.08	5.3	3.1	37.0	4.63	51.3	6.18	19.46	9.7	197.6
1928	13.80	10.59	5.3	4.1	58.2	4.98	44.6	5.50	15.40	83	5.9
1927	18.24	12.45	6.4	4.4	79.5	4.90	50.8	4.83	16.46	11.2	114.2
1926	8.92	6.50	6.0	4.4	37.7	4.86	47.6	5.36	16.00	12.9	19.7
											20.6
											21.2

d Deficit.

has the option to pay something to the other or not, at his own election, since, if the dividend is not declared at the end of the year, the benefits of the accumulated profits are practically lost to these stockholders. Such a construction should be avoided if any other is reasonably open, because it would result in temptation to unfair dealing.¹⁵

Having thus quoted the legal status of the payment of dividends by the directors of corporations as one important form of yield and having set forth in the preceding Chaps. XV and XX the details of possible interest yields to those who have loaned money, we may now more appropriately study the interrelation of the various types of yield with capitalization and stockholders' equities. In the preceding tables (XLII to XLV inclusive) may be found the values of most of the important ratios defined in Chaps. XV and XX for four typical large manufacturing and merchandising corporations throughout the years 1926 to 1934.

There have been set forth in this chapter the normal limitations placed upon net income, or yield to the investor, as a ratio either to capitalization or to allowable bond interest, for public utilities as stipulated by a regulatory commission (for which, see more in Chap. XXVI); the variations of such yields by days and by years; and the test ratios that are regularly used to analyze the probable yield of various corporations. The effects of income taxes which tend to reduce the actual net yield to the investor below that declared by the corporation were explained and the various criticisms and means of neutralizing such reductions were outlined. Court decisions of moment were cited, as the result of which a few unusual and infrequent requirements were brought to bear upon the directors of certain corporations to pay larger dividends contrary to the customary practice of boards of directors to use their own judgment in such disbursements. Finally the use of standard financial reference sources of valuable information for investors was explained and the financial ratios of typical companies were quoted as examples of such possible analyses.

Specific References

1. WARDENBURG, H. A.: "How to Increase the Usefulness of the Accountant in the Electric Light and Power Industry," *Edison Elec. Inst. Bull.*, August, 1934.
2. WILLCOX, O. B.: "Cost of Money and Credit of Utilities," *Elec. World*, June 5, 1920.

3. "Back to Senior Financing," *Elec. World*, Jan. 3, 1931.
4. "Money and the Markets," *Business Week*, Aug. 25, 1934.
5. Moody's Utilities, 1936.
6. BLAKELY, ROY S., and GLADYS C. BLAKELY: "Revenue Act of 1936," *Am. Econ. Rev.*, vol. 26, p. 466, September, 1936.
7. *Ibid.*; also *House Report* 2475, p. 19, 74th Congress 2d Session.
8. Editorial, *Business Week*, Oct. 31, 1936.
9. *Excelsior Water & Mining Co. v. Pierce*, 90 Col. 131, 27 Pac. 44 (1891).
10. *Beers v. Bridgeport Spring Co.*, 42 Conn. 17, 26 (1875). Also 11 Ga. A 440, 75 S.E. 508 (1912).
11. 93 N.Y. 192 (1883).
12. 26 Atl. 887. The court was not speaking of stock dividends in the technical sense, but only of ordinary dividends on stock.
13. *Dodge v. Ford Motor Co.*, 204 Mich. 459, 170 N.W. 668 (1919).
14. REITER, PROSPER: "Profits, Dividends and the Law," Ronald Press Company, New York, 1926.
15. *Burk v. Ottawa Gas & Electric Co.*, 87 Kans. 6, 123 Pac. 857, 860-61.

Review Questions

1. It is determined that a cash capital of \$1,000,000 is required to build and equip a certain light and power plant. The public service commission will allow 7 per cent net return and 2 per cent depreciation on the cash valuation; 70 per cent of the cash value is in 5 per cent bonds, and a 7 per cent preferred-stock issue is such that the dividends thereon are earned one and one-half times over after deducting the bond interest from the net income. The bonds are sold at 10 per cent discount, the preferred at 5 per cent discount, and the common at par. If the operating expense is \$100,000 and the fixed charges exclusive of interest, dividends, and depreciation are \$30,000 and the surplus is half the balance of the net income after bond interest and preferred dividends are paid, what is the gross income and the per cent earned on the common stock?

2. It is estimated that a certain public utility will cost \$1,000,000 in cash. The financial market is such that 5 per cent bonds can be sold at 85 per cent, 7 per cent preferred stock at 90 per cent, and common stock at par. However, in order to raise \$1,000,000 in cash, all three forms of securities must be used.

Public utility regulation limits the bond issue to 75 per cent of the valuation (cash value) or requires that the bond interest shall not exceed half the net income, whichever condition governs. Also the par value of the preferred stock is limited to 55 per cent of the cash value after the cash value of the bonds has been deducted from necessary cash capital or it is required that the dividends thereon must not exceed two-thirds of the net income after the bond interest has been deducted, whichever condition governs.

With a gross income of \$300,000 and an operating ratio of 80 per cent including depreciation, taxes, and insurance, what is the maximum possible yield on the common stock, in per cent, if none of the above regulations are violated?

3. A public utility corporation is valued at \$4,000,000. The gross revenue is \$1,000,000 with an operating ratio of 50 per cent (not including depreciation). The company is financed by \$2,500,000 of 5 per cent bonds which were sold at 95, \$1,000,000 of 6 per cent cumulative preferred sold at 90, and the remainder by common stock sold at 50. Fixed charges, not including interest, are 6 per cent. If this corporation is allowed to earn a fair return of 6 per cent, is the gross revenue sufficient? What is the maximum dividend that could be declared to the common stockholders?

4. The cash capital of a corporation is \$500,000. The common stock has a par value of \$100,000 but is sold at a discount of 20 per cent. It pays a dividend of 8 per cent. Preferred stock with a par value of \$200,000 is sold at 90 per cent and bears a 7 per cent dividend. The remainder of the total cash capital is secured by the sale of bonds at 95 per cent which bear 6 per cent interest. The annual operating expenses are \$85,000. The depreciation fund is 5 per cent, the taxes 1 per cent, and the insurance 3 per cent of the cash capital.

- a. What is the net income if the surplus is equal to the common-stock dividend?
- b. What is the gross revenue?
- c. What is the operating ratio?
- d. What is the total par value of the stocks and bonds outstanding?

5. A public utility corporation has a cash capital of \$10,000,000. This cash capital was obtained from the sale of bonds, preferred stock, and common stock, each to the maximum par value possible under the following stipulations: (1) the par value of 5 per cent bonds must not exceed 70 per cent of the cash capital and the interest thereon must not exceed half the net income; (2) after deducting the par value of the bonds from the cash capital, the par value of the 6 per cent preferred stock issue must not exceed half the remaining cash capital and the dividends thereon must not exceed two-thirds of the remaining net income after deducting the bond interest; (3) the remaining cash capital is to be raised by the sale of common stock, but only half the remaining net income may be used for dividends thereon, after the bond interest and preferred stock dividends shall have been paid.

In this company the cash capital turn over is 4 to 1, the operating ratio excluding depreciation is 48 per cent, and the fixed charges, including depreciation but excluding interest, is 7 per cent of the cash capital. Bonds had to be sold at 95 per cent of par, preferred at 90 per cent of par, and common at 85 per cent of par.

- a. What is the per cent fair return on the cash capital invested?
- b. What are the par and cash values of the bonds?
- c. What are the par and cash values of the preferred stock?
- d. What are the par and cash values of the common stock?
- e. What is the per cent return on the common stock?

6. A hydroelectric plant cost \$200 per kilowatt of capacity. In addition the transmission line, which is 200 mi. long, costs \$10,000 a mile for its installation. Operating expense and maintenance are \$1,440,000 per annum. Straight-line depreciation is allowed at 4 per cent per annum upon the total investment. The capacity of the plant is 50,000 kw. Sixty per

cent of the original cost is met by a bond issue of 5 per cent bonds, the balance by the sale of stock. The plant is allowed to earn a net return of 8 per cent of the original investment. Determine:

- a. The gross revenue.
- b. The dividend that might be paid upon the stock after paying out of the 8 per cent revenue the interest on the bonds and the depreciation charge.
7. A company plans to build a new power plant which will cost \$5,000,000. This cash capital is to be raised from the sale of bonds, preferred stock, and common stock. The net income from the operation of the plant is estimated to be \$400,000 per annum.
 - a. If the ratio of the net income to bond interest requirement is 4 to 1, how many 5 per cent \$1,000 bonds can be sold at \$1,050 each?
 - b. How much 7 per cent preferred stock can be issued at 98, if the ratio of face value of bonds to preferred stock at par is 2 to 1?
 - c. How much common stock remains to be sold?
 - d. What is the maximum possible dividend to be paid on common stock?

CHAPTER XXII

ECONOMIC SELECTION

Economic selection asks the basic question, "Will a proposition pay?" but in the engineering sense it asks a great deal more than that. Economic selection may involve a triode of questions, "Why do it at all?" "Why do it now?" as well as "Why do it this way?" It may involve a choice between two or more undertakings or merely the choice between a certain enterprise and no enterprise at all. In all cases "Will it pay?" means "Will it pay in the long run?" A structure with the lowest first cost will not necessarily result in the lowest cost in the long run. Such items as lower efficiency, higher maintenance and repairs, and shorter useful life may easily consume the difference in first cost between the cheaper structure and the more expensive one.

Economic selection is the comparison of costs and revenues to determine net incomes or yields on invested capital. Whether the enterprise under consideration is the development of a \$1,000,000 power plant or the purchase of a \$25 radio, the process is much the same.

Although engineering economy and personal economy involve the same basic considerations, the relative importance of the various factors entering into the choice of an article may be widely different. For example, in purchasing an electric refrigerator for the home, appearance might easily be a major factor in a specific choice, while, in the same purchase for a commercial laboratory, appearance might conceivably be the least of the factors influencing the choice. In this connection it may be said that economic selection in the various fields of engineering involves the personal equation to a much less degree than in individual purchases or undertakings.

Since, except in rare instances, all the various factors involved in a problem of economic selection cannot be reduced to a dollar-and-cents value, personal judgment must be exercised to a considerable extent. However, judgment in this case must not be

confused with a mere guess or hunch. The latter often would result in serious financial losses, while the former, if based, as it should be, on thorough analysis, knowledge of and experience in such matters, and a knack of foreseeing possible contingencies, may be as potent in influencing a decision as some concrete numerical figure. It is chiefly for this reason that engineers find a large proportion of their time devoted to problems of economic selection. If it were simply a matter of adding up a column of figures, any competent clerk could handle the work satisfactorily.

In any problem of economic selection the first step in the analysis consists in breaking the problem down into all the factors affecting the choice to be made and determining the relation of these factors to each other. If the problem is large or complicated, each major factor may require further analysis. After analysis is complete, the various factors, major and minor, are arranged into two principal groups. The first group contains those factors which are known or definitely predictable and the value or cost of which may be expressed in dollars and cents. The second group contains those factors whose value or cost cannot be reduced to a dollar-and-cents basis. The factors in the second group are called judgment factors. As an illustration of such a factor, consider appearance in the above example of the refrigerator. Even the most experienced of engineers would have difficulty in expressing appearance quantitatively, to say nothing of the impossibility of reducing a given amount of appearance to a money value. Another phase of the same condition results where the factor being weighed is known in amount but its effect upon choice is not reducible to the common denominator of money. For example, delivery on machine *A* is definitely promised in 30 days, while machine *B* cannot be promised within 60 days. In this case the difference in deliveries between the two machines is easily determined but its effect upon the choice between machines *A* and *B* is by no means so simple of calculation or even of determination.

For convenience in analysis, the first group of factors is frequently further subdivided into fixed charges and operating expenses. The term "fixed charges" has been used extensively throughout this text to embrace those costs which are proportional to the capital invested, it being constant in nature and generally independent of the quantity of production. For the

purpose of economic selection, fixed charges generally include (1) interest on invested capital, whether actually borrowed or not, (2) insurance, (3) taxes, and (4) depreciation. Operating expenses, on the other hand, are already more nearly proportional to the output or production of the enterprise. Examples of typical operating expenses would be (1) wages, (2) fuel or power, (3) heat, light, and water, and (4) repairs, maintenance, and supplies.

After the analysis is complete and all the data are collected and arranged or classified into fixed charges, operating expenses, and judgment factors, it is necessary to draw a conclusion therefrom and to express that conclusion in the most effective way to accomplish the purpose for which the study was made.

One of the following five methods is usually available for drawing a conclusion from the data collected.

1. Minimum-cost point.
2. Break-even point.
3. Per cent of annual return on extra investment.
4. Comparative annual cost including interest.
5. Present worth or capitalized cost.

Each of these will now be discussed and illustrated.

Minimum-cost-point Method.—When the total cost of a project is made up of several variables, some of which increase and others of which decrease with some feature of the design or construction under question, the problem can generally best be expressed by the minimum-cost-point concept. One of the most outstanding examples of a minimum-cost-point problem is the application of Kelvin's law to the selection of the most economical size of wire to use in a distribution or transmission system. In this case carrying or fixed charges on the wire increase directly as the size but the cost of energy dissipated in heat decreases as the square of the size. Since both of these functions are continuous, it would seem that the calculus might afford a ready means of solution. For this particular case the calculus could be used or an algebraic formula derived for determining the minimum-cost point. However, not all minimum-cost-point problems have continuous functions of this nature, so that the calculus is not always satisfactory. Moreover, the calculus gives the absolute minimum when frequently values in the neighborhood of the absolute minimum may differ but slightly, thereby

giving the engineer, in the economic sense at least, if not in the mathematical sense, a latitude in which to exercise judgment. For instance, most things come in standard sizes, ratings, or dimensions. It would ordinarily be uneconomical for an engineer to specify a wire slightly less in diameter than some standard diameter just because some calculus calculation showed that the smaller diameter was the most economical. The cost of drawing a wire with a special diameter would more than offset the economy that would result. This principle applies equally well to machine ratings and building supplies and materials.

In the case of copper wire, the cost of energy wasted at 30°C. may be calculated as follows:

$$\text{cost of energy} = \frac{I^2 R H C_e}{1,000} = \frac{I^2 \frac{L}{A} H C_e}{1,000} = \frac{10.8 I^2 L C_e H}{1,000 A}$$

where L = length of wire in feet, H = number of hours the effective current I flows, C_e = cost of energy in dollars per kilowatt-hour, and A = area of wire in cir. mils.

The carrying charges of the copper wire installed for copper weighing $3,026 \times 10^{-9}$ lb. per circular mil foot may be calculated as follows:

Annual cost of copper installed =

$$3,026 \times 10^{-9} \times L \times A \times C_e \times \frac{P}{100}$$

where C_e is the cost in dollars per pound of copper installed and P is the carrying charges on the investment expressed in per cent.

The annual cost is the sum of these two expressions and for a given load, costs, etc., the annual cost may be expressed as

$K_c \frac{1}{A} + K_e A$. Graphically the result is as shown in Fig. 39.

From this graph or by the calculus the minimum-cost point may be proved to be where the *annual cost of energy wasted* is equal to the *annual cost of the conductor in place*.

Equating the above two expressions and solving for A gives $A = 597 I \sqrt{H} \sqrt{C_e / C_c P}$ for the most economical size of conductor to use where I is constant for H hr.

If I is constant for an entire year of 8,760 hr.,

$$A = 55,800 I \sqrt{C_e/C_c P}.$$

If I is varying, then the annual effective value of the varying current must be used for the I in the above formula. The effective value is, of course, the square root of the mean square and is determined as in part (c) of the following problem when the magnitude of the current and the hours of its duration are known.

Determine the most economical size of conductor, according

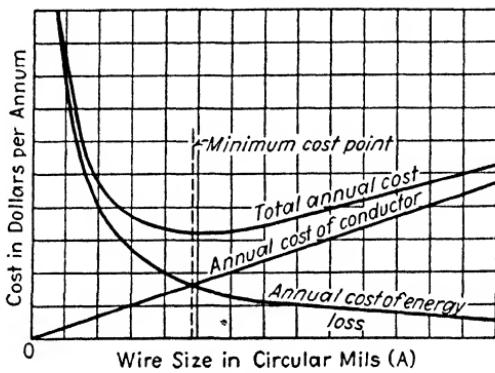


FIG. 39.—Graph illustrating Kelvin's law.

to Kelvin's law, to use in the following cases, if copper costs 20 cts. a pound installed, energy costs 3 cts. per kilowatt-hour, and the fixed charges are 15 per cent:

- Load current per wire is 40 amp. for 4,000 hr. a year.
- Load current per wire is 20 amp. for one year.
- Load current per wire is 20 amp. for 1,000 hr., 10 amp. for 2,500 hr., 40 amp. for 500 hr., and no current for the remaining hours of the year.

Solution:

a. $A = 597 \times 40 \times \sqrt{4,000} \sqrt{0.03/0.2 \times 15} = 1,510,303 \times 0.316 = 477,256 \text{ cir. mils}$

b. $A = 55,800 \times 20 \sqrt{0.03/0.2 \times 15} = 116,000 \times 0.316 = 352,656 \text{ cir. mils}$

c. Annual effective current =

$$\sqrt{\frac{20^2 \times 1,000 + 10^2 \times 2,500 + 40^2 \times 500 + 0}{8,760}} = 12.85 \text{ amp.}$$

$$A = 55,800 \times 12.85 \sqrt{\frac{0.03}{0.2 \times 15}} = 716,930 \times 0.316 = \\ 226,550 \text{ cir. mils}$$

In selecting the most economical size of conductor for a given case, Kelvin's law is not the only factor that must be given consideration. Other factors of equal importance are:

1. Safe current-carrying capacity.
2. Excessive voltage regulation.
3. Mechanical strength.
4. Corona losses.
5. Materials other than copper would require the calculation of a different constant.

One other point is worthy of consideration. The calculation of whether or not it would be economical to replace an existing conductor with a larger one involves a comparison of the present worth or net salvage value of an existing structure with a new one. By net salvage value is meant the actual or estimated salvage value less the cost of removal upon which it is necessary to base calculations of interest, depreciation, etc., for the purpose of calculating the annual cost of continuing the existing installation. In studies of this sort the formula form of Kelvin's law is not directly applicable as it considers only the investment in the new conductor. It is usually better to calculate the carrying charges and cost of energy wasted for several specific sizes in the neighborhood of the one to be replaced and to compare the annual cost of each with that required to keep the existing wire in use. As shown in Fig. 39, the annual-cost curve is fairly flat in the vicinity of the minimum-cost point and it might be that, although a larger size may be slightly more economical, the yield on the extra investment may not be sufficiently high to warrant the undertaking, to say nothing of the trouble involved.

As an example, suppose that a certain No. 6 cable now has a steady current of 13 amp. flowing in it instead of the 8 amp. upon which its size was chosen five years ago and that it is desired to make a study to determine whether it would pay to replace this cable with a larger one at this time. Assume that copper costs 20 cts. a pound, energy 2 cts. per kilowatt-hour, interest 7 per cent, taxes and insurance 2 per cent, and depreciation 5 per cent, and that the line operates 4,000 hr. a year. Also it is

estimated that it will cost \$8 per 1,000 ft. to remove the old wire and that its scrap value will amount to 14 cts. per pound. No additional investment in poles, crossarms, insulators, or hardware will be required.

TABLE XLVI.—DETERMINATION OF THE DESIRABILITY OF REPLACING AN EXISTING CABLE WITH A LARGER ONE

I	Size of wire, American wire gauge	6	5	4	3
II	Resistance (ohms per 1,000 ft.)	0.395	0.313	0.248	0.197
III	Weight (lb. per 1,000 ft.)	79.46	100.2	126.4	159.3
IV	Investment in wire per 1,000 ft.	\$15.89	\$20.04	\$25.28	\$31.86
V	Depreciation to date (5 per cent, 5 years)	\$ 3.97			
VI	Estimated salvage value	\$11.92			
VII	Actual salvage value at 14 cts. per lb.	\$11.14			
VIII	Net salvage value (VII - \$8)	\$ 3.14			
IX	Net investment (IV - VIII)	.....	\$16.90	\$22.14	\$28.72
X	Fixed charges (0.14 VIII) or (0.14 IX)	\$ 0.44	\$ 2.37	\$ 3.10	\$ 4.02
XI	Kw.-hr. at 13 amp. and 4,000 hr.	267	212	168	133
XII	Operating expense (0.02 XI)	\$ 5.34	\$ 4.24	\$ 3.36	\$ 2.66
XIII	Annual cost (X + XII)	\$ 5.78	\$ 6.61	\$ 6.46	\$ 6.68
XIV	Saving per 1,000 ft. over No. 6 wire	.....	None	None	None
XV	Kw.-hr. at 16 amp. and 4,000 hr.	405	321	254	202
XVI	Operating expense (0.02 XV)	\$ 8.10	\$ 6.42	\$ 5.08	\$ 4.04
XVII	Annual cost (X + XVI)	\$ 8.54	\$ 8.79	\$ 8.18	\$ 8.06
XVIII	Saving per 1,000 ft. over No. 6 wire	.....	None	\$ 0.36	\$ 0.48

It will be noted that the actual salvage value (line VII) is less than the estimated salvage value (line VI). Also note that the net salvage value (line VIII) is the one actually used to determine the net investment. Some accountants might object to this practice but, when an article is carried on the books at a certain figure and later it is discovered that this figure is fictitious, there is no logical alternative than to take the new figure and write off the loss.

In the case of regulated public utilities, however, the logically obvious policy to pursue is less frequently the one actually taken because the rate base is affected. For instance, in the No. 5 wire, the actual value of the new investment is \$20.04 and, if a

valuation was made at the time of installation, that value is presumably the one that would be used. For the purpose of comparison in an economic study, however, the net investment of \$16.90 is more logical. It was the one used in the above table. In spite of this conservative approach, the data of line XIV show no saving in changing to a larger size of wire at this time. Kelvin's law gives a value of 41,400 cir. mils, which is close to a No. 4 wire as the most economical conductor to use if only a new installation is under consideration. Yet according to Table XLVI (lines XV to XVIII inclusive) the load would have to increase to 16 amp. before any saving would result in a replacement program. Since, however, 16 amp. is twice as big as 8 amp., a wire twice as big as No. 6 or No. 3 proves in.

Another illustration of the concept of the minimum-cost point that might be mentioned is the determination of the most economical lot size to manufacture or to purchase. In the manufacturing process the object manufactured is frequently of such a nature that parts for it are made in large quantities on machines or purchased outside for assembly in the final structure. Frequently these machines are used for different parts. For example, a certain automatic screw machine might turn out part A for a while and then be set up for part B. In many cases the fluctuation of the output, local conditions, and the nature of the product may render futile any calculation that is based on anything other than actual experience and previous practice. In other cases it is possible to arrive at the most economical lot size to manufacture or purchase for a given set of conditions.

In this connection the major costs involved are:

1. Cost of preparation of materials, tools, and the setting up of the machine. In the case of purchase this item reduces to office overhead.

2. The cost of working capital tied up in the materials and parts manufactured or purchased.

3. Cost of storage space in which to keep the parts thus manufactured or purchased.

It is obvious that, in case 1 above, the larger the lot manufactured or purchased at one time, the less the cost per unit in the lot, but in case 2, the larger the lot, the more capital will be tied up therein and the greater will be the expense for the use of this capital. Finally, the more manufactured in any one lot, the

larger the space required to store the article and the larger the cost per unit will be involved for case 3 above. This is a typical minimum-cost-point situation, where some variables increase with size of lot while others decrease.

A question immediately presents itself as to the effect of the maximum, average, and minimum inventories upon each of the above items. In general, as the parts are being made they are also being used, but the rate of making exceeds the rate of using so that a stock accumulates. The size of lot decided upon and the difference between these two rates determine the maximum inventory. The maximum inventory, in turn, determines the storage space that must be provided. The cost of working capital tied up in parts is most appropriately based upon the average inventory. The minimum inventory may be ignored in the determination of the most economical lot size as it will be a constant for all lots of whatever size for a given article.

An example will illustrate the technique of such an analysis: The production schedule of a certain article requires 240,000 pieces *A* per year of 300 working days. The machine that makes piece *A* can turn out 2,400 a day. Expenditure per piece for materials, labor, and overhead, but excluding machine preparation, is \$0.50. The cost of preparation of the machine for a run is \$50. Storage space suitable for pieces *A* will cost \$0.05 per piece. Annual interest on working capital tied up in the average inventory amounts to 15 per cent.

TABLE XLVII.—MOS T ECONOMICAL LOT SIZE TO MANUFACTURE

I	Lot size	10,000	12,000	14,000	16,000	18,000	20,000
II	Lots per year (240,000/I)	24	20	17	15	13.3	12
III	Maximum inventory ($\frac{1}{2}I$)*	6,667	8,000	9,333	10,667	12,000	13,333
IV	Investment in average inventory ($\frac{1}{2}I \times \$0.50$)	\$1,667	\$2,000	\$2,333	\$2,667	\$3,000	\$3,333
V	Cost of working capital (IV $\times 0.15$)	\$ 250	\$ 300	\$ 350	\$ 400	\$ 450	\$ 500
VI	Cost of preparation (II $\times \$50$)	\$1,200	\$1,000	\$ 850	\$ 750	\$ 666	\$ 600
VII	Cost of storage (III $\times \$0.05$)	\$ 333	\$ 400	\$ 467	\$ 533	\$ 600	\$ 667
VIII	Total annual cost (V + VI + VII)	\$1,783	\$1,700	\$1,667	\$1,683	\$1,716	\$1,767

* Maximum inventory = $I - (I/2,400 \times 800) = I(1 - \frac{1}{3}) = \frac{2}{3}I$.

It will be noticed that the most economical lot size (line VIII) is 14,000.

The calculus might be used on this problem in the following manner: Let *X* = number of thousands of pieces in a lot. Then

$$\begin{aligned}
 \$ &= 50 \times \frac{240,000}{10,000X} + 0.5\left(\frac{1,000X}{3}\right)0.15 + 0.05\left(\frac{2,000X}{3}\right) \\
 &= \frac{12,000,000}{1,000X} + 25X + 33\frac{1}{3}X \\
 &= \frac{58\frac{1}{3}X^2 + 12,000}{X} \\
 \frac{d\$}{dX} &= \frac{X(117X) - 58\frac{1}{3}X^2 - 12,000}{X^2} = \frac{58\frac{1}{3}X^2 - 12,000}{X^2} \\
 &\quad 58\frac{1}{3}X^2 - 12000 = 0 \\
 &\quad X^2 = 206 \\
 &\quad X = 14.33
 \end{aligned}$$

Lot size = 14,333 for the most economical manufacture. This value corresponds closely to that found in Table XLVII.

Break-even Point Method.—In a problem involving this concept, the annual costs of both methods under consideration increase with some feature of design, such as size, for instance; but one increases faster than the other, with the result that, in general, there will be a point where they are equal. Above this point, called the break-even point, one method is more economical, while below this point the other method is more economical. Here again the best method of illustrating the technique involved by a break-even-point analysis is to use illustrative problems.

One very common form of this problem involves two machines, one of which costs more but is of higher efficiency than the other. The first machine will cost more in annual carrying charges but, if it is used sufficiently, the annual cost may be less than the second. The question is, how many hours of use will make the two annual costs equal? For example, the purchase of a 50-hp. induction motor is being considered. Machine *A* is offered at \$500 with a guaranteed full-load efficiency of 93 per cent. Machine *B* is offered for \$400 with a guaranteed full-load efficiency of 90 per cent. If the machines always operate at full rated load, at what number of hours use per year will the annual cost of both machines be the same? Fixed charges may be taken as 15 per cent and energy as 2 cts. per kilowatt-hour.

$$\begin{aligned}
 \text{Annual cost of } A &= \$500 \times 0.15 + \frac{50 \times 0.746}{0.93} \times \$0.02H \\
 &= 75 + 0.802H
 \end{aligned}$$

$$\begin{aligned}
 \text{Annual cost of } B &= \$400 \times 0.15 + \frac{50 \times 0.746}{0.90} \times \$0.02H \\
 &= 60 + 0.833H \\
 75 + 0.802H &= 60 + 0.833H \\
 0.031H &= 15 \\
 H &= 484
 \end{aligned}$$

In this problem 484 hr. per annum is the break-even point. Below 484 hr. use of rated output, the cheaper motor is the more economical, but above 484 hr. use, the more expensive motor is the more economical. At 484 hr. they are equal in annual expense.

Again the break-even point may involve the price to be paid for raw materials of two different grades, as in the following problem:

A higher B.t.u. coal costs 50 cts. a ton more than a lower B.t.u. coal. You can generate 1 kw.-hr. per pound of the higher B.t.u. coal and 0.856 kw.-hr. per pound of the lower B.t.u. coal. Determine the price per ton of the lower B.t.u. coal at which it makes no difference which you buy.

TABLE XLVIII.—BREAK-EVEN POINT ON THE PRICE OF COAL

Low B.t.u. coal			High B.t.u. coal		
Cost per ton	Cost per lb.	Cost per hw.-hr.	Cost per ton	Cost per lb.	Cost per kw.-hr.
\$1.00	\$0.0005	\$0.00058	\$1.50	\$0.00075	\$0.00075
2.00	0.0010	0.00117	2.50	0.00125	0.00125
3.00	0.0015	0.00175	3.50	0.00175	0.00175
4.00	0.0020	0.00234	4.50	0.00225	0.00225
5.00	0.0025	0.00292	5.50	0.00275	0.00275

In this problem, as shown by Table XLVIII, the break-even point is \$3 per ton of the lower B.t.u. coal. Thus, if the price remains below \$3, it is cheaper in the long run to buy the poorer quality coal, but, if the price raises above \$3 a ton, it will be cheaper in the end to buy the better quality coal at 50 cts. more per ton. At just \$3 a ton it makes no difference whether you buy the cheaper coal at \$3 a ton or the more expensive coal at \$3.50 a ton.

Per Cent of Annual Return on Extra Investment.—When there is an element of risk involved in the possible undertaking of something new, it is more convincing to express the gain resulting from the new project as a percentage of the extra money that must be invested in the proposition. In other words, a yield of only 2 or 3 per cent will not ordinarily be conducive to the undertaking of a possible risk, to say nothing of the work and worry involved, but, if there is a possibility of a yield of 10 or 15 per cent, it is more likely to receive favorable consideration.

As an example, consider the problem of the manufacturer who now employs ten testers at an annual salary of \$1,200 each and operates ten test positions, valued at \$500 each; he is considering the investment of \$80,000 in automatic testing machines to do all the above testing with only two of the above testers. Assume that repairs, replacements, power, light, heat, and factory space cost \$1,000 a year for the present installation, and that an estimated cost of \$300 is sufficient for the proposed installation. Fixed charges exclusive of interest may be taken as 10 per cent on the old positions and as 6 per cent on the new positions. Money is worth 7 per cent.

TABLE XLIX.—CALCULATION OF YIELD ON NEW INVESTMENT

	Old investment	New investment
First cost.....	\$ 5,000	\$80,000
Fixed charges.....	500	4,800
Operating expenses.....	1,000	300
Wages.....	12,000	2,400
Total.....	\$13,500	\$ 7,500
Annual saving in favor of new method.....	.....	\$ 6,000
Annual per cent yield in favor of new method...	.....	7½ %

If money is worth 7 per cent to this company, there is only a margin of 0.5 per cent in favor of the new installation. When we consider the possibility of failure of the new automatic machines with the consequent interruption of production, the difficulty of finding employment elsewhere for the replaced personnel, the training of operators for the new machines, and the inevitable difficulties during the change over, it would not seem that 0.5 per

cent was worth the effort, especially when slight changes in production might easily eliminate even that. This example illustrates the importance of judgment factors in the final choice.

By way of contrast, consider another problem confronting this manufacturer. A new product is being considered, the manufacture of which may be accomplished by either of two methods *A* or *B*. Method *A*, which uses a machine costing \$10,000 with a life of ten years, is capable of 20,000 operations daily and requires one operator at \$150 a month. Method *B* uses a machine costing \$18,000 with a life of fifteen years and is capable of 30,000 operations daily, but it requires one skilled operator at \$200 a month. Taxes and insurance combined may be taken as 4 per cent per annum and straight-line depreciation may be assumed with no scrap value. Based on a production schedule of 60,000 operations daily, will the additional investment in the more expensive machine be justified?

TABLE L.—YIELD ON EXTRA INVESTMENT

	Method <i>A</i>	Method <i>B</i>
Cost of machines needed.....	\$30,000	\$36,000
Taxes and insurance.....	1,200	1,440
Depreciation.....	3,000	2,400
Wages.....	5,400	4,800
Total.....	\$ 9,600	\$ 8,640
Annual saving in favor of method <i>B</i>.....	.....	\$ 960
Annual yield as per cent of the extra investment	.....	16 %

In this case, the investment of the \$6,000 additional required for method *B* yields 16 per cent on that investment. If money is worth 7 per cent to this company, there is a margin of 9 per cent to cover possible errors in estimates or changes in production. In other words, the yield is sufficient to warrant the risk involved in making the additional investment.

Comparative Annual Cost Including Interest.—This method of making an economic selection is only a slight modification of the "per cent yield on the extra-investment method" just discussed. It is suitable for comparing several items of a similar nature where the cost facts are all known or easily determined and where estimates and risks are reduced to a minimum. It

usually assumes that one of the alternatives will be selected in any event. The question is not shall a thing be done but which one of several things shall be done?

As an example, suppose that you must buy a storage battery for your automobile and that three batteries are available according to the following table:

TABLE LI.—CHOICE OF AN AUTOMOBILE STORAGE BATTERY

Designation	A	B	C
First cost.....	\$15	\$12	\$ 9
Years of life.....	3	2	1½
Service charges per year.....	\$ 1	\$ 2	\$ 3
Interest on money.....	7%	7%	7%
Taxes and insurance.....	5%	5%	5%
Depreciation.....	\$ 5	\$ 6	\$ 6
Taxes and insurance.....	\$ 0.75	\$ 0.60	\$ 0.45
Interest.....	\$ 1.05	\$ 0.84	\$ 0.63
Service charges.....	\$ 1	\$ 2	\$ 3
Annual cost.....	\$ 7.80	\$ 9.44	\$10.08
Saving A over B.....	.....	\$ 1.64	.....
Saving A over C.....	.....	.....	\$ 2.28

Table LI clearly shows battery *A* to be the best buy if you intend to keep your car for at least three years. If the interest item is omitted in the above table, the saving of battery *A* over battery *B* is \$2.70, which amounts to a 45 per cent return on the extra investment in battery *A*. This is $45 - 7$ or 38 per cent more than your money is worth, but 38 per cent of the extra investment of \$6 is \$2.28, the saving resulting in Table LI. Thus, as previously stated, the "yield on the extra-investment method" and the "annual-cost method including interest" are very closely allied and interchangeable if desired. Which to use, in a given case, depends upon the elements of risk involved. As a further example of the application of the annual-cost method, see the study of the most economical method of correcting for poor power factor contained in Chap. XXVII.

Present Worth or Capitalized Cost.—This method is more frequently applied to the problem of determining the present equivalent of a series of incomes resulting, for example, from the saving of an annual salary or wage bill over a period of years. Examples of this type of problem can be found in Chap. XIV.

TABLE LII.—COMPARISON OF TWO TYPES OF BUILDING CONSTRUCTION

	Type X	Type Y
Cost of construction.....	\$100,000	\$115,000
Depreciation.....	2 %	1 %
Insurance on building.....	80 cts. per \$1,000	40 cts. per \$1,000
Insurance on contents.....	\$1 per \$1,000	50 cts. per \$1,000
Taxes.....	2 %	2 %
Interest.....	6 %	6 %
Maintenance, repairs, and renewals..	3 %	2 %
Contents equal to the value of the building.		
<i>A. Per cent return on extra investment</i>		
Depreciation.....	\$2,000	\$1,150.00
Insurance on building.....	80	46.00
Insurance on contents.....	100	57.50
Taxes.....	2,000	2,300.00
Maintenance, repairs, and renewals..	3,000	2,300.00
Total.....	\$7,180	\$5,853.50
Saving.....	.....	\$1,326.50
Yield (\$1,326/\$15,000) = .....	.....	8.84 %
<i>B. Annual cost including interest</i>		
Total from (A).....	\$ 7,180	\$ 5,853.50
Interest.....	6,000	6,900.00
Total annual cost.....	\$13,180	\$12,753.50
Saving.....	.....	\$ 426.50
Check with (A) (0.0884 - 0.06)	.....	.....
\$15,000 = .....	.....	\$ 426.50
<i>C. Capitalized cost</i>		
Depreciation.....	\$ 33,333	\$ 19,166
Insurance on building.....	1,333	766
Insurance on contents.....	1,667	958
Taxes.....	33,333	38,333
Maintenance, repairs, and renewals..	50,000	38,333
Interest.....	100,000	115,000
Total capitalized cost.....	\$219,666	\$212,556
Saving.....	.....	\$ 7,110
Check with (B) (\$7,110 × 0.06) = .....	.....	\$ 426.50

In some cases where the proposed construction is of the nature of a permanent structure, such as a bridge or trestle, it is of advantage to know the sum of money which, if put to work at a fixed percentage, will carry the annual cost of the structure indefinitely. Railroads frequently use this method in grade- or curve-elimination projects.

As an example of the relation of the last method to the two previous ones, consider the following construction problem:

Two types of construction are being considered for a factory building. Both types are similar but type *Y* is more fire resisting than type *X*. Estimates are as shown in Table LII.

The various items in method *C* above are all obtained by capitalizing each item in method *B* at the interest rate prevailing, namely, each item is divided by the rate of interest to obtain its capitalized value or the sum which, if kept working at the prevailing interest rate, will carry that item indefinitely.

Summary.—The few simple problems shown in this chapter to illustrate the basic concepts included therein should not be taken to mean that these concepts are of minor importance or of narrow application. On the contrary, the minimum-cost-point concept and the break-even-point concept both find almost unlimited application in all branches of engineering and production processes. To list them all or even a representative group for all fields of engineering activity becomes very burdensome.

It is hoped that those given and the review problems that follow will suffice to stimulate the engineer to apply the principles involved to his own problems in whatever branch of engineering he may be interested.

It must be admitted, and it cannot be too highly emphasized, that no set combination of figures or mathematical laws can take the place of engineering judgment and common sense. Each individual problem met in engineering must be thoroughly saturated with these two ingredients or the best results will fail to materialize. Coupled with these, there is need of actual experience in the particular field in which a specific problem is found, in order intelligently to exercise sound judgment. Because of the inherent difficulty of teaching these intangible but highly important elements in the classroom, it is essential that the student make the most of every opportunity given him to practice the exercise of engineering judgment. In this respect he

must be content to obtain results in simple things first as a foundation upon which to build greater things later. With this in mind much may be learned, if the young engineer will analyze his own personal purchases from time to time. Finally, as a measure of his success in this respect, about the only recourse the student has is to compare his results with those from someone more experienced in the particular subject than himself. The more outstanding the authority he consults, the better.

Review Questions

1. Distinguish between engineering economy and personal economy.
2. What are fixed charges?
3. What are operating expenses?
4. What are judgment factors?
5. What methods are available for making a choice in a problem of economic selection?
6. How do you recognize a minimum-cost-point problem?
7. How do you recognize a break-even-point problem?
8. When would you use the per cent of annual return on extra investment method?
9. When would you use the annual-cost method?
10. When would you use the capitalized-cost method?

Review Problems

1. A farmer at a distance of 1 mi. from a transmission line may secure electric service by either one of the following methods:
 - a. He may build the 1 mi. of 2,200-volt distribution line at his own expense, which is estimated at \$1,200 per mile, and purchase energy at his home for 4 cts. per kilowatt-hour. Fixed charges on the line are 15 per cent.
 - b. The company will build the line if he guarantees a minimum bill of \$20 per month at a rate of 10 cts. per kilowatt-hour.

The first year he uses 1,200 kw.-hr. and all other years 3,000 kw.-hr. Which of these two alternatives is more desirable?

2. A 4/0 aluminum cable weighs 1028 lb. per mile and has a resistance of 0.423 ohms per mile. If it costs 20 cts. per pound for cable installed and electrical energy is worth 1.5 cts. per kilowatt-hour, what is the most economic value of current that can be transmitted over such a circuit 2.5 mi. long for 10 hr. per day, 365 days per year? Assume interest at 6 per cent and depreciation of 3 per cent.

3. A current of 150 amp. is to be transmitted over a 500,000 cir. mil cable of copper 2 mi. long during 10 hr. per day for 365 days per year. Energy costs 1 ct. per kilowatt-hour; fixed charges are estimated to be 10 per cent of investment. What is the cost of cable per pound for most economical transmission?

4. A copper feeder 1 mi. long is supplying 200 amp. effective current for 8 hr. per day and 300 days per year with an energy cost of $1\frac{1}{2}$ cts. per kilowatt-hour. The feeder costs 20 cts. per pound installed. Fixed charges are 12 per cent of investment. What size of feeder would you select? Why?

5. A 500,000 cir. mil copper cable 2 mi. long is installed as a 600-volt direct-current railway feeder at a cost of 30 cts. per pound. Using values of resistance and weight from tables of "Standard Handbook for Electrical Engineers," calculate the following:

a. Total cost of cable.

b. Fixed charges on cable at 12 per cent per annum.

c. Cost of energy per annum wasted in I^2R , heat losses with an effective current of 200 amp., flowing 10 hr. per day and 300 days per annum at a charge of 2 cts. per kilowatt-hour.

d. Voltage regulation in per cent.

6. Same as Prob. 5 for a 4/0 cable transmitting the same current.

7. Same as Prob. 5 for a 750,000 cir. mil cable transmitting the same current.

8. a. Plot fixed charges in dollars per annum of Probs. 5, 6, and 7 against cable size in circular mils.

b. Plot on same chart cost of energy wasted per annum in dollars against cable size.

c. Plot curve of total annual cost against cable size.

d. Which is the most economical size to install in accordance with Kelvin's law?

e. What other conditions should be considered before selecting this cable?

9. With the price of copper approximately 15 cts. per pound, should a larger or smaller cable be selected for such service? Why?

10. The current in a cable varies from hour to hour in accordance with the following ammeter readings throughout a typical day:

Hours	Cur- rent, amp.	Hours	Cur- rent, amp.	Hours	Cur- rent, amp.
12 M. to 6 A.M.	25	12 M. to 1 P.M.	50	5 P.M. to 6 P.M.	525
6 A.M. to 7 A.M.	50	1 P.M. to 2 P.M.	400	6 P.M. to 8 P.M.	500
7 A.M. to 8 A.M.	125	2 P.M. to 4 P.M.	450	8 P.M. to 10 P.M.	300
8 A.M. to 9 A.M.	200	4 P.M. to 5 P.M.	500	10 P.M. to 12 M.	100
9 A.M. to 12 M.	300				

a. What is the effective current for the 24 hours?

b. At what rate per kilowatt-hour for I^2R energy would the cost of such loss just equal the 10 per cent fixed charges on 2 mi. of 750,000 cir. mils copper cable supplying this effective current 365 such typical days per annum with copper at 15 cts. per pound?

- c. What is the regulation in per cent at maximum load?
d. At the effective value of current?
11. A 33,000-volt, three-phase, three-wire transmission line transmits 5000 kw. at 80 per cent lagging power factor 3,000 hr. a year. Each wire used costs 15 cts. per pound installed. Fixed charges may be considered as 15 per cent and the cost of energy is \$0.01 per kilowatt-hour. What is the most economical size according to Kelvin's law?
12. A copper railway feeder 1 mi. long with negligible resistance ground return supplies 100 amp. current for 18 hr. per day and 365 days per year with an energy cost of 1½ cts. per kilowatt-hour. The feeder costs 15 cts. per pound installed. Fixed charges are 12 per cent of the investment. What size of feeder would you select?
13. A three-phase transmission line 40 mi. in length is being designed. It is estimated that the cost of copper in place is 15 cts. per pound, energy is worth 1 ct. per kilowatt-hour, and fixed charges are 12½ per cent. If the load is estimated to average 30,000 kw. at 0.8 power factor for 4,000 hr. per year and zero load for the rest of the year:
- What should be the most economical size of conductor according to Kelvin's law if the line voltage is 66,000 volts? Copper weighs 0.00000303 lb. per cir. mil foot.
 - What other factors might affect the size and kind of conductor?
14. A 66,000-volt, three-phase transmission line is to transmit 10,000 kw. at 80 per cent power factor for 3,000 hr. per annum. Energy lost in transmission costs 0.75 ct. per kilowatt-hour and fixed charges are estimated at 12 per cent. Suitable copper cable would weigh 2,130 lb. per mile and cost, installed, 14 cts. per pound. Suitable aluminum cable would weigh one-third as much, but it would have twice the resistance and would cost 22 cts. per pound.
- Which cable is the more economical? (Show all calculations.)
 - According to Kelvin's law, what would the price of copper and aluminum have to be in order to make each, respectively, an economical selection?
15. A feeder has the following load variations, at constant potential, during a typical day of a 365-day year:

Ammeter readings:

	Amperes
12 M. to 5 A.M.	50
5 A.M. to 8 A.M.	75
8 A.M. to 12 A.M.	200
12 M. to 1 P.M.	50
1 P.M. to 5 P.M.	150
5 P.M. to 10 P.M.	75
10 P.M. to 12 P.M.	50

- a. What is the effective current?
b. At what cost of energy per kilowatt-hour would a 4/0 cable (211,600 cir. mil. section) prove to be the most economical if copper

costs 15 cts. per pound installed and fixed charges are 10 per cent? Weight of 4/0 feeder = 640.5 lb. per 1,000 ft. and resistance 0.05 ohms per 1,000 ft.

16. If the cost of energy expended in I^2R loss in a cable is \$500 per annum and its fixed charges are 15 per cent, what is the most economical weight of cable to install with copper at 20 cts. per pound?

17. A series street-lighting circuit is rated 6.6 amp. and operates 4,000 hr. per year. Copper costs 18 cts. per pound installed, fixed charges are 12½ per cent, and energy is \$0.012 per kilowatt-hour on the primary side of the lighting transformer. What is the most economical size of copper conductors to use in accordance with Kelvin's law?

18. The proposed change from a 4/0 to a 750,000 cir. mil cable in a distribution system has been estimated to cost \$1,500, upon which amount the company must charge off 15 per cent per annum as fixed charges. If the energy saving resulting from the larger cable is figured at 1 ct. per kilowatt-hour, how many kilowatt-hours *per month* must be saved to warrant the installation of the larger cable?

19. The load on a three-phase three-wire transmission line is such that it transmits 100 amp. for 10 hr., 50 amp. for 4 hr., and 25 amp. for 10-hr. per day for 365 days per year. Each wire used weights 2,130 lb. per mile, has a resistance of 0.42 ohm per mile, and costs 15 cts. per pound installed. Fixed charges may be considered as 15 per cent.

a. What would the cost of energy have to be to make the above wire the most economical size according to Kelvin's law?

b. What are the other factors to be considered in choosing wire sizes?

20. Copper may be purchased at 14 cts. per pound or aluminum at 22 cts. per pound. Copper has a resistivity of 10.6 ohms per cir. mil foot and aluminum a resistivity of 16.5 ohms per cir. mil foot. Weight per cir. mil foot of copper is 0.0000303 lb. and that of aluminum 0.0000092 lb. For equal conductivity, which material is the cheaper? Why?

21. A telephone company has the privilege of installing one of the following poles:

a. Yellow pine pole, fully creosoted at \$16 each and with an estimated life of 50 years.

b. Western cedar butt-treated pole at \$11 with a life of 25 years.

c. Untreated northern white cedar at \$8 with a life of 15 years.

The cost of setting each pole may be estimated at \$4 for each variety. What would be the percentage saving on the extra investment of the most economical pole over its nearest competitor? Calculate depreciation on straight-line basis.

22. A white cedar pole will cost \$18 installed and will have a life of 25 years. A fully treated yellow pine pole of a similar size will cost \$25 installed but will have a life of 40 years. Depreciation may be calculated on a straight-line basis. Insurance and taxes are 2 per cent. Which is the better buy if interest is 7 per cent?

23. An untreated western red cedar pole costs \$20 and is estimated to last 20 years. The cost of setting this pole is \$10 extra. How much could a company afford to pay for the same size pole which was treated to give a

life of 50 years, if the market rate of money is 8 per cent? Depreciation may be calculated on the straight-line basis. Because of the increased weight the second pole will cost \$12 for its installation. Neglect taxes and insurance.

24. a. The price of a certain wood pole is \$9 delivered. The life of the pole may be estimated at 10 years. How much extra could be paid for a preservative treatment for this pole in order to "break even" if the life would be increased 5 years by the preservative? Installation cost for each pole may be figured at \$5. Use straight-line depreciation.

b. In (a), if the preservative treatment may be purchased for \$1.75 extra, what per cent return will be secured on the extra investment?

25. Motor A, rated at 50 hp., costs \$500, has an efficiency of 85 per cent. Fixed charges, including depreciation, are 10 per cent and energy costs 5 cts. per kilowatt-hour. Repairs and maintenance amount to \$10 a year.

Motor B, rated at 50 hp., costs \$700, has an efficiency of 90 per cent. Fixed charges, including depreciation, are 10 per cent and energy costs 5 cts. per kilowatt-hour. Repairs and maintenance are \$8 a year.

How many hours would these machines have to operate a year to make the annual cost of both the same?

26. Two motors A and B are being considered, one of which must be bought.

	Motor A	Motor B
Rating (horsepower and speed).....	50-1,800	50-1,800
Voltage and frequency	2,300-60	2,300-60
Phases.....	3	3
Weight, lb.....	2,500	2,000
Space needed, sq. ft.....	25	20
Life, years (estimated).....	20	15
Scrap value (estimated).....	\$100	\$50
Full-load efficiency, per cent.....	92	90
Full-load power factor, per cent.....	90	87
Interest charges, per cent.....	6	6
Insurance, per cent.....	1	1
Taxes, per cent.....	3	3
Depreciation (5% sinking fund).....	?	?
Maintenance.....	\$5	\$10
First cost.....	\$850	\$750
Installation costs.....	\$75	\$70

Operation of both machines: full load, 4 hr. a day, 300 days in a year, with energy at 3 cts. per kilowatt-hour.

Using the annual-cost method, determine all the advantages of one machine over the other, both tangible and intangible.

27. Transformer A, rated at 2,000 kva., three-phase, 33,000-2,200 volts, with full-load efficiency of 96 per cent, is quoted at \$10,000 f.o.b. factory

with freight and installation costs estimated at \$500 extra. A competing transformer *B* of the same rating, with guaranteed efficiency of 98 per cent, at full load is quoted at \$13,000. The latter weighs 10 per cent more with freight rate per hundred weight the same. If the average output is assumed to be the full-rated load at 100 per cent power factor, delivered 24 hr. per day and 300 days per year, with primary energy costing 1 ct. per kilowatt-hour, which transformer would you purchase? Why?

28. If the transformer selected from Prob. 27 were to be operated at 80 per cent power factor on its secondary side and if the regulation and efficiency were lowered in *A* 3 per cent and in *B* 2 per cent as a result of the low power-factor load, would you change your selection for the same kva. output? Why?

29. Two transformers *A* and *B* of equal size are being considered with the following performance.

	Efficiency at full load, %	Losses, no load, kw.	Losses, full load, kw.	Losses, total, kw.
<i>A</i>	98.4	7	9.2	16.2
<i>B</i>	98.6	6	8.2	14.2

Load curve = full load 2 hr. per day, three-fourths load 6 hr. per day, and no load 16 hr. per day.

Assume interest 7 per cent, depreciation 6 per cent, taxes 3 per cent, and insurance 1 per cent. How much more could each of the following users afford to pay for transformer *B* than for transformer *A*:

- a. A hydroelectric plant with excess water power continuously available.
 - b. A steam plant with capacity costs of \$90 per kilowatt per year and fuel costs of $\frac{1}{2}$ ct. per kilowatt-hour.
 - c. A manufacturer buying energy at $2\frac{1}{2}$ cts. per kilowatt-hour.
 - d. A manufacturer buying energy at 1 ct. per kilowatt-hour and a maximum demand charge of \$2 per kilowatt per month.
- 30.** Two grades of coal cost \$2 and \$2.40 per ton, respectively. The cheaper coal has 10,000 B.t.u. per pound while the other has 12,500 B.t.u. per pound. A power plant can produce a kilowatt-hour for \$0.01, using 1 lb. of the higher priced coal. By adding economizer equipment worth \$50,000, the cheaper coal may be used and the price per kilowatt-hour kept the same. How many kilowatt-hours per year output should be supplied by the plant in order that the extra expense may be justified? Interest is 7 per cent, depreciation 6 per cent, insurance and taxes 2 per cent.

- 31.** The XYZ Electric Company pays ten clerks \$20 a week to get out 10,000 bills per month. What can be paid for automatic billing machines in order just to break even if the new machines will require only two operators at \$30 a week? Operating and maintenance on the new machines amount to \$50 a month and fixed charges (including interest) may be considered as 10 per cent of the investment.

32. Ice for a family of four costs \$40 a year. An electric refrigerator costs \$196. Cost of operation is \$2 per month. Money is available at 6 per cent. Maintenance and repairs are also 6 per cent. Life is estimated at 20 years. Would you advise the purchase or not? Why?

33. Two automobile storage batteries *A* and *B* are quoted at \$6 and \$7.50, respectively. *A* has to be given an extra charge once every six months at a cost of 75 cts., while *B* has to have an extra charge only once each year. *A* has a life of 2 years while *B* has a life of 3 years. Fixed charges are 10 per cent in addition to depreciation. Which battery is more economical and how much? Use straight-line depreciation.

34. A certain cement plant operating on an average of 360 days a year with an output of 3,000 bbl. of cement every 24 hr. has installed 4,800 hp. in motors. Its average demand over a 24-hr. day is 1,700 kw. and its maximum demand measured over a period of 15 min. is 2,300 kw. Power is supplied to the plant by a central station at a rate of \$1 per month per kilowatt maximum demand, plus 1 ct. per kilowatt-hour, based on an average power factor of 85 per cent. For power factors other than 85 per cent, the energy charge is changed in the inverse ratio of the power factors.

- On the basis of a power factor of 85 per cent, what is the total cost of energy per barrel of cement?
- If low-speed induction motors are used for most of the drives, the power factor will not be over 75 per cent. What will be the added energy charge per barrel of cement?
- What is the most economical kilovolt-ampere rating of synchronous condensers for power-factor correction, to be used in conjunction with the induction motors of (b), assuming that the losses of the condensers are 5 per cent of their rating, and that the condensers cost approximately \$12 per kilovolt-ampere. Assume also 18 per cent fixed charges.

	Type A	Type B
Cost of construction....	\$50,000	\$75,000
Depreciation.....	5 %	2 %.
Insurance on building..	90 cts. per \$1,000	45 cts. per \$1,000
Insurance on contents..	\$1.20 per \$1,000	60 cts. per \$1,000
Taxes.....	2 %	2 %
Interest.....	7 %	6 %
Maintenance, repairs, and renewals.....	5 %	3 %

35. In a certain factory the production schedule requires 30,000 of pieces *A* per year of 300 working days. The machine that makes piece *A* can turn out 300 pieces a day. Expenditure per piece for materials, labor, and overhead but excluding preparation cost is 10 cts. each. The cost of preparation of the machine for a run is \$10. Storage space for pieces *A* will cost 1 ct. each. Annual cost of working capital tied up in the average inventory

amounts to 10 per cent per annum. What is the most economical lot size to manufacture?

36. Two types of construction are being considered for a building. Estimates are as follows. If the contents are equal to 50 per cent of the valuation, which type of construction is the most economical in the long run?

37. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

- T F From a purely economical standpoint, the choice of a distribution cable is a minimum-cost-point problem.
- T F Kelvin's law for the economic selection of feeder cable will require a smaller cable if aluminum is substituted for copper. Assume the cost of aluminum to be three times the cost of copper per pound, resistivity twice that of copper, and weight one-third that of copper.
- T F Two methods *A* and *B* of accomplishing a given project are being considered. The costs of both *A* and *B* methods increase with the volume of output but the cost of method *A* at low outputs is higher than *B*, and at large outputs *B* is higher than *A*. The best method to use is most satisfactorily determined by the break-even point.
- T F Minimum annual cost is always the best basis for the selection of new equipment.
- T F Other requirements having been equally well satisfied, the feeder having the shortest period of current flow should have the smallest sectional area.
- T F An increase in storage cost of maximum inventory increases the most economical lot size to manufacture if the other costs remain constant.
- T F A problem in economic selection should be solved and presented in such a manner as to impress the executive having final disposition thereof.
- T F If the factors affecting the cost of a proposition increase at different rates with its size, the minimum-cost-point method is the best one to use in determining the most economical size to use.
- T F Where the economic risk is great, the annual-cost method including interest is the best one to use.
- T F The capitalized-cost method of selection is the best method where the proposition is permanent and of exceptionally long life.

CHAPTER XXIII

PUBLIC SERVICE CORPORATIONS

A NATURAL MONOPOLY

The control of public service is a relic of medieval times. The principal difference at present lies in the fact that a smaller number of activities are considered as public services now than in those early days. Tailors, bakers, ferrymen, and blacksmiths were then considered as performing public services as well as victualers and innkeepers. When the landlord and tenant system, in vogue at that time, classified society rigidly and the landlords furnished the capital, if it could be called such, the landlords dictated strict rules for the regulation of these public services.

Public service usually resulted from a monopoly or complete control, locally at least, of some public necessity. Such a monopoly may have arisen from one or more of the following limitations:

1. Source of Supply.—Adequate and sanitary water supply for a community may easily be limited to one or a few local sources. The small householder, who hauls water of questionable sanitary quality from a near-by river or well, would hardly be considered a competitor of the local town or city waterworks.

Natural gas was easily controlled within a limited area. Riparian rights may limit the available hydroelectric plants and the service rendered by them to those holding such grants.

2. Difficulty of Distribution.—Local difficulties, physical or financial, of establishing and maintaining an adequate distribution system for such necessities as water, light, power, transportation, communication, etc., may easily establish for the first system developed in a community the nucleus of a monopoly, which with the gradual growth of the system may prove unassailable to a prospective competitor. For example, those who supply water through pipes are performing a public service while those who sell bottled water are not.

In a famous gas utility case as early as 1858, Justice Smith of Milwaukee reversed a decision of the lower court with the following pertinent decision:

Corporations of this kind are not like manufacturing or trading corporations whose productions may be transported from market to market throughout the world. Its manufacture depends upon the consumption in the immediate neighborhood for its profit and success and upon no other place. From the nature of the article, the objects of the company, their relations to the community, and from all the considerations before mentioned, it is to me apparent that the company is not at all analogous to the ordinary trading and manufacturing corporation.

3. The Time Element.—Such organizations as may have been able, by reason of patent privilege, pioneering foresight, or the acquisition of a limited number of agencies, to provide adequate and rapid service of transportation, communication, lighting, or other necessities of life have by reason of such time limitations created for themselves a monopoly of such service. A consumer, who is desirous of rapid transportation or communication, will pay the monopolistic price demanded by the airplane pilot or the telegraph or telephone company rather than wait for the lower priced railroad or mail service.

4. Economic Monopoly.—The large financial investments in generating stations for electricity and artificial-gas plants, the terminal stations and rights of way of railroads and superpower transmission lines, and the gigantic telephone exchanges and toll lines of our large cities practically eliminate the possibility of the subsequent establishment of a competing duplicate or adequate substitute. Such a condition confirms the monopolistic status of the original owner of the service which has been gradually developed and so thoroughly entrenched from an economic standpoint.

Thus the telephone was predicted by Justice Reese as early as 1885 never to have a duplication of system. From an economic standpoint duplication of plant by competitive service companies is a sheer waste of money and, in the long run, a sheer waste of the consumer's money.

CORPORATIONS IN PUBLIC SERVICE

In the early days the corporate form of organization was first applied to public service. Private business was incorporated

considerably later. Exclusive franchises and elaborate charters were granted to protect the public effectively:

The law says to those in public business, you must do this for the applicant and you must do it thus and so. To those in private business, however, it says, you must not do this, or, if you do this, you must do it thus and so. This is the chief distinction between public and private calling: in the one there is a *coercive* law, intimate in its details; in the other, there is a *restraining* law, general in its rules.

This situation led to the undertaking of every advantage not specifically prohibited by charter and soon the public was suffering from discrimination as the result.

The acquisition by small groups of individuals of monopolies over certain public necessities such as water, gas, transportation, etc., and the sale or donation of certain valuable and exclusive rights and franchises by the municipalities and states to the early corporations established, very early in the nineteenth century, a marked distinction between public service and private corporations. The public was in many instances so anxious to have such service inaugurated that, not only were the laws lax in connection with the organization of such corporations, but little or no regulation was prescribed for them, even when they were enjoying absolute monopolies in a community. Many a city at the present time is suffering from inadequate railroad service or from the inconvenience and embarrassment of a railroad running through one of its main streets as the result of too generous, indefinite, or perpetual franchises granted decades ago by overenthusiastic public officials. The state charters issued to the early public service corporations were also very lax in their requirements of those upon whom the public was absolutely dependent for service.

This condition is well illustrated by a quotation from the *Paterson Gas Light Case* in 1858. Buildings of the plaintiff consumer were on the gas mains of the defendant company but the former was refused service.

The language of the charter throughout is permissive and not compulsory. The company may organize, may make and sell gas, or not at their pleasure: and I see no more reason to hold that the duty of doing so is meant to be imperative than to hold that other companies incorporated to carry on manufacture, or to do any other business, are

bound to serve the public any further than they find it to their interest to do so.

Such interpretation from the courts, coupled with carelessly worded charters in many instances, encouraged competition, upon a small scale, and a very free and easy epoch resulted, from which the consumer suffered from inadequate service, although rates might have been temporarily low in some cases. In the end the consumer necessarily paid for such duplication and laxity. This was termed the period of "laissez faire" and the railroads were said to be operating upon the "public be damned policy."

Such epochs generally have their reactions, however. The stronger corporations, financially and politically, gradually gained valuable franchises and control was obtained over the weaker ones. The fact that a corporation had privileges of eminent domain, rights to use of streets, etc., led the courts gradually to the decision that such corporations were indeed public servants and as such should serve all applicants equitably who made a reasonable request for their services. Ability, willingness, and special privilege to serve the public became the test of the public servant and still greater privileges, more responsibilities, and strict regulation by the state were gradually extended to those engaged in such enterprises. Although there was considerable confusion in determining which corporations were public servants and which were not, the following court decision, handed down by Chief Justice Shaw in 1883 (in marked contrast to that previously quoted), cleared the atmosphere considerably and outlined the duty of the public service corporation rather effectively:

The supply of a large number of inhabitants with pure water is a public service. But, it is urged, as an objection to the constitutionality of the act, that there is no express provision therein requiring the corporation to supply all families and persons who should apply for water on reasonable terms: that they may act capriciously and oppressively: and that by furnishing some houses and lots and refusing others they may thus give a value to some lots, and deny it to others. *This would be a plain abuse of their franchise. By accepting the act of incorporation they undertake to do all the public duties required by it.*

A very good general definition of a public utility and a quasi-public utility is as follows:*

* BARKER, HARRY, "Public Utility Rates," McGraw-Hill Book Company, Inc.

A concern having special rights to use public property (like highways) and serving the general public conducts a true "public utility" when its service has passed the state of being a mere luxury or convenience *for the few* and has become a *necessity* in the conduct of *business* and *ordinary life of the many*. Before that condition is reached, the concern does merely a "quasi-public" business, more or less of public interest and in which the government has specific limited rights to interfere.

This definition does not exclude all concerns whose business does not immediately involve every citizen (as does that of a water company); it includes enterprises, like electricity supply works, which serve many citizens, but by no means all, and whose service is a growing public convenience though seldom a complete necessity.

Industries which are recognized as being "affected with a public interest" are frequently considered to be public utilities. However, Martin G. Glaeser points out very appropriately in an article entitled "The Meaning of Public Utility" that such a

. . . legal conception of a public utility is a fixed concept with a changing content; that is, the industries now recognized as affected with a public interest will not necessarily be the industries which the law of the future will classify as public utilities. The industrial and political situation of the time, and particularly the state of public opinion, will determine (a) the number and kind of industries classified as public utilities, (b) the elaboration of the system of rights and duties which make up the institution, (c) the regulating agencies employed, (d) the instrumentalities of regulation, whether rules of law, positive statutes, charters, or special franchises and (e) the subordinate administrative standards which are applied as a matter of practice. The trend in the development and application of the institution will be a resultant of the weight of social inertia, of the pressure of the economic environment, and of the influence of intellectual progress. . . . When gas was no longer an effective substitute, collective judgment declared electricity a public utility. Thus the concept of public utility becomes an instrumentality in the *improvement of the standard of life*.*

In spite of many very good general definitions, however, courts and commissions have rather difficult distinctions to draw between private, quasi-public, and public service corporations. For example, electric lighting and intercommunicating telephone

* GLAESER, MARTIN G., "The Meaning of Public Utility—A Sociological Interpretation," *J. Land and Public Utility Econ.*, Vol. 1, 178-188, 1925.

systems in large office buildings have gradually extended their services across alleys and streets into neighboring buildings, thereby furnishing rather general service at different rates from those prescribed by the state. When do such growing concerns become public utilities? Telephone companies at one time claimed that, since the pay stations only were for public use, they were not obliged to put a telephone into a particular private residence unless they desired to do so. The court held that, if the telephone company stood ready to put telephones in some residences, it must do so in all for which proper application was made. The street railways represent a clear case of the public servant, but a subway in Boston, Mass., owned by the city and leased to a corporation for operation offered a more difficult problem. The court finally decided that the operating corporation was a public servant. A company owning a pole line and offering the use of its poles to another corporation must thereby throw open its pole line to others who may apply. In a noted case in Florida, the court to which appeal was taken from the decision of the railroad commission held that the commission was justified in requiring a railroad terminal company to grant the use of its terminal stations and yards to a third railroad.

The difficulty in definitely distinguishing between the public utility and private corporations has led to a very detailed statement in most public utility laws as to the corporations which shall be governed thereby. An extract from the Indiana Spencer Shively Public Service Commission Act of 1913, which, together with those of several other states, is very similar to the Wisconsin Law of 1907, will illustrate the specific nature of such definitions:

"The term 'public utilities' was defined to include street or interurban railway, telephone, telegraph, heat, light, water, power, elevator, and warehouse utilities, whether privately or municipally owned."

When considering the difference between public service corporations, thus defined, and private enterprises previously described, it should be distinctly kept in mind that the public utility corporation holds a monopoly upon a public necessity. The public must have water, light, and transportation continuously, even if the cost is excessive. The public will not, however, long withstand excessive rates if such are charged by

corporations to which this same public has granted special privileges and franchises. These conditions have resulted in state regulation of the rates, the service rendered, and often the financing of public service corporations in nearly every state in the union. This is done by appointive public service commissions, whose work is outlined in detail in a later chapter.

The relative merits of various methods of dealing with such monopolies, which include municipal ownership, state regulation, and federal control, operation, and ownership of the various public service corporations, have been and are still being thoroughly discussed in the press. Many books have been written upon this problem. Governmental operation of the interstate railroads, the steamship corporations, and the telephone and telegraph utilities during the World War, although a necessity under the state of war, introduced many innovations into utility management and into the relations between public service corporations and the public which were very difficult to readjust upon a peace basis. It has been frequently proposed that, in the march of events through the next few decades, state and federal regulation, as existent at present, may give way to federal operation and ultimately to federal ownership, particularly in the case of railroads. One author has recently pointed out the fact that governmental control of rates and wages upon the railroads means practically governmental operation as well. This is his conclusion in the following quoted analysis:

Government control of rates means government control of gross earnings; government control of wages and working conditions (as wages take 60 cts. out of every dollar of operating cost) means control of operating cost; and, as it is generally agreed that the government must either guarantee a fair return on railroad investments or provide the money needed, the government will control the net income. This is practically the unanimous judgment of the men in this country who favor so-called "private ownership and operation" and are best qualified to judge. Now you may call that condition "private ownership and operation" if you choose (just as you may misuse words at your pleasure in a free country), but it isn't. It is government operation in fact and in effect, and if the opinions of the experts are of any value there appears to be no alternative.*

* CABOT, PHILIP, "Government Operation of Public Utilities," *Elec. World*, Aug. 16, 1919.

The author proceeds to emphasize the well-known fact that, with income guaranteed by the government, i.e., from our taxes, and without a measure of competition between corporations and among employees and officers striving for better results, it will be very difficult to obtain the high-grade service enjoyed under regulated private ownership. The problems connected with the return to the latter condition after the war are, however, among the most difficult yet faced by our legislators up to the present time. They affect every individual of every community in the nation so vitally that all should make a study of this intricate situation and its possible analyses and solutions.

The other utilities, such as water, gas, urban street railway, and possibly the more or less localized telephone corporations have, in general, for the last decade, been operating satisfactorily to consumer and stockholder under state commission regulation, which provides limited gross revenue on the one hand and protection against cutthroat competition on the other. The urban and interurban railways, however, have been handicapped both with respect to gross income and credit even with state commission regulation and many have been forced into the hands of receivers, sold at auction, and discontinued during the past decade. The psychology of the nickel as a maximum charge for a streetcar ride has had much to do with the difficulty in increasing railway gross revenue to values that will maintain good service, adequate credit, and bond interest, not to mention stock dividends.

Turning from the public utility problems of control and regulation, which will be discussed in greater detail in a later chapter, to those of corporate organization, little difference will be noted in contrast to corporations in general, as previously discussed. It is seldom that an entirely new corporation is organized for public service in a town or city of sufficient population to offer any difficulty. Many corporations are formed or reorganized in completing consolidations or in changing from private to municipal ownership or vice versa.

In such cases it is necessary to study carefully the specifications of the public service legislation of the state as well as that directed toward corporations in general. State public service commissions may have a great deal to say regarding the organization of such a corporation. The state of Wisconsin, one of

the first states to grant rather radical powers to a public service commission, a practice since followed in considerable detail by many other states, protects the public from the ultimate cost of duplicate utilities and the investor from the serious effects of competition by granting to a utility what is called an "indeterminate permit" to carry on its business. Under these permits, for which the original franchises of the utility were at first voluntarily surrendered, utilities are limited to a period of good behavior and good service. In 1911 an amendment to the original Wisconsin act repealed all the utility franchises in the state and granted indeterminate permits in lieu thereof. This was possible in Wisconsin because of the fact that the state constitution gives the legislature the power to alter or repeal any franchise. In some of the other states not having this provision, the surrender of the franchise for an indeterminate permit has been necessarily made optional with the utility. In all cases the corporation has been given protection against competition in return for the surrendered franchise. No competition will be allowed unless in the judgment of the commission "public convenience and necessity" demand it.

Municipal ownership has, nevertheless, been encouraged by such legislation, since the municipality can purchase the property at any time upon a valuation to be fixed by the commission, following a favorable referendum vote of the people.

With these limitations placed upon the organization of new utilities and the reorganization and merging of old utilities, a very much more extensive preliminary investigation is necessary than with private corporations. Not only must the normal corporate procedure and the legislation regarding private corporations be studied, in the state of proposed incorporation, but the exacting requirements of the public service commission must be analyzed and the legal, political, and psychological relations of such monopolies to the public, to the consumer, to the employee, and to the stockholder must be discovered and thoroughly mastered by the prospective public utility engineer and executive.

Review Questions

Place a circle around the letter T or F in front of the following statements according to whether you consider each of them to be true or false, respectively:

- T F A monopoly is necessarily an evil to society.
- T F The grant of a monopoly is a public grant combined with the public right to regulate.
- T F Superior advantages of the location of an existing light and power plant over any other in the locality tend to create a natural monopoly.
- T F Physical terrain is never a factor in the monopolistic character of an existing transportation system.
- T F To abolish a monopoly it is necessary to duplicate equipment.
- T F The expense of duplication of terminal facilities may in itself exclude competition in the case of a railroad.
- T F Attempting to abolish a monopoly by running one type of transportation in parallel with another, such as a bus line and a steam railroad, may result in the elimination of the steam railroad.
- T F The detrimental result of the absence of competition when a monopoly exists can be largely corrected by governmental regulation.
- T F From the standpoint of the public, there is no advantage in public utility monopolies.
- T F Natural-gas plants and hydroelectric plants are inherently less monopolistic than artificial-gas and steam-electric plants.

CHAPTER XXIV

MUNICIPAL OWNERSHIP

This controversial question inquiring into the advantages of municipal ownership of public utilities over private corporate ownership, or vice versa, will probably never be settled. It has no common answer for all local conditions. It has, however, many worth-while arguments pro and con, with which the engineer administrator should be familiar. Its political phases, often found to be cropping out to obscure the true economic and engineering analyses of any particular community study, will be avoided herein as far as possible.

The basic questions that the community and the prospective engineer employee or manager must answer sooner or later are:

1. Why should the municipal government operate an electric-light, street-railway, or gas plant?
2. Is there any more reason why the water, fire-protection, and post-office services should be publicly operated?
3. Broader still is the basic question: is the operation of public utilities really a function of government?
4. If so, upon what theory can the activities of government in the utility business be justified?
5. What has been the experience of the municipally owned public utilities in the past with respect to: (a) service rendered, (b) rates charged for such service, (c) continuity of service, (d) possible extension of service to outlying districts, (e) dependency of personnel, (f) permanent tenure of personnel, (g) accuracy of accounting, allocation of funds, etc.?
6. Is success or failure in one community or in other countries a criterion for corresponding success or failure in any other locality?
7. Should such a municipally owned public utility be assisted partially by taxation of the entire community?
8. What effect would the displacement of privately owned public utilities by municipally owned public utilities have upon

the service of the former to other cities and to the suburban and rural districts?

9. If the state public service commissions were empowered to regulate municipally owned public utilities, as they do in some states and as they do with privately owned utilities, would the advantages of the municipal plants be augmented thereby?

10. Can the incentive to expand the service rendered and the ambition to acquire advancement and responsibility on the part of employees be developed in government service as in the private corporation?

It is not the purpose of this book to enter into a detailed discussion of these necessarily unanswerable questions or to enter the currently active problems of federal and state ownership and operation of public utilities. Much has been written, frequently with definite bias and some misrepresentation, upon both sides of these questions. For those who wish to analyze this situation, further reference should be made to the bibliography at the end of this chapter. However, the young engineer should have before him and should consider carefully before entering public utility employment, either private or governmental, the peculiar limitations and the probable future trend of each.

For this purpose, therefore, experience and data are presented supporting each side of the question, from which the engineer must choose and make his decision. The pertinent questions raised may, therefore, be categorically discussed as follows:

1. The municipal government should continue to operate an electric-light, street-railway, or gas plant if it has done so successfully in the past, if it renders adequate service, if it has low costs for its consumers and renders necessary no abnormal or unbalanced transfers of funds and no taxation of the many for the advantage of the few. If the municipality has not thus operated a public utility in the past, but can show possibilities of doing so throughout a long term of years in the future in accordance with these criteria of success which have been outlined above, it may be warranted in purchasing and operating such a public utility or in building a new one which does not duplicate other private services. Seldom, if ever, however, is the simultaneous and parallel operation of municipal and private utilities of the same type in the same community successful over a period of years if accounts are correctly kept and if no outside

funds are drawn upon for the purpose. Although competition between such duplicated utilities may temporarily provide lower rates to the consumer, the engineer and ultimately the consumer will readily appreciate the fact that duplication of plant and equipment with adequate regulation must result in higher return, i.e., higher rates, if both companies are to earn a reasonable profit.

Conversely, if adequate service, lower costs to consumers, avoidance of abnormal or unbalanced transfers of funds, and the impossibility of unequal or excessive taxation cannot be assured, there seems to be no reason, from a technical or economic standpoint, why the municipality should continue or enter upon public utility ownership of electric-light, street-railway, or gas corporations. An additional reason is that many, if not all, of these advantages may be attained by the privately owned corporation because of its physical and financial interconnections, if adequately regulated by the state and/or federal governments.

2. Although, upon first thought, it would seem that the success of the publicly owned and operated postal-service, fire, police, and water utilities might justify the extension of such public management to electric power, railway, and gas operation, yet the postal service must necessarily be interstate and therefore federal in its nature even though operated at a loss; the fire and police services are for the protection of *all* inhabitants, for which *all* should pay their share whether the service is used or not; the water utility, possibly more on the border line of the argument and therefore frequently privately owned and operated, is more of an absolute necessity, the purity of its supply must be conserved by the municipality to insure a healthful environment, and its use is required by practically all inhabitants, thereby rendering it justifiably a possible tax burden for all. Furthermore, street-railway and water systems of adjacent municipalities are not readily interconnected for their mutual advantage of continuity of service and maintenance, while the gas service to some extent and the electric service to a very great degree are interconnected to the mutual advantage of themselves and their consumers, although they are not necessarily interstate in their character of bulk transmission as is the case of steam railroads and the postal system.

3. "Society," said the late Calvin Coolidge, "requires certain public activities, like highways and drainage, which are used in

common and can best be provided by the government. But in general the country is best served through the competition of private enterprise. . . .

"Our theory of society rests on a higher level than communism. We want the people to be owners of their property in their own right."¹

Abraham Lincoln is quoted as having said, "The legitimate object of government is to do for a community of people whatever they need to have done, but cannot do at all, or cannot so well do, for themselves in their separate and individual capacities. In all that the people can individually do as well for themselves, government ought not to interfere."²

This question of public utility operation resolves itself down to whether or not the people need the service and whether or not they can provide it themselves. Subsequent discussion will enable the young engineer to decide these questions.

Furthermore, since services undertaken by the government are necessarily supported by the taxation of a large percentage of the population (a larger percentage in recent years than ever before), it would appear that the services rendered should be general and not limited to customers only, as is the case of the public utilities.

4. Wherever natural resources, such as natural gas and water power, presumably the valuable inheritance of all inhabitants, can be best or only developed by governmental administration and funds, it would seem to be a function of such a government to distribute such services as equitably and as economically as possible to as large a percentage of the populace as possible. Such a problem, it must be remembered, however, is but a small and highly localized portion of the broad case of rendering all types of utility services to the relatively few applying therefor. This is also rather a federal than a municipal enterprise.

When the government does enter such a business, it would seem reasonable for it to act in the same capacity as the private corporation as far as legally possible, and therefore be required to render the same grade of tax-free service at a profit; at least it should not be a drain upon other public funds. The Wisconsin constitution specifically forbids the state from engaging in business. "The state shall never contract any debts for work of

internal improvement or be a party in carrying out such work (section 10)."

"It has been held that when a city goes into a commercial business, such as the furnishing of utility service, it takes upon itself the character of an ordinary commercial concern and to that extent ceases to function in its governmental capacity."³

In the often-quoted case in the city of Logansport, Ind., in which an attempt was made by the existing administration to use the profits of the municipal electric light plant to build municipal offices for all departments of the city rather than to reduce the rates, notwithstanding the fact that the losses of the plant during previous administrations had been supplied by general taxation, it was ruled by the Supreme Court of Indiana that "when a municipal corporation engages in an activity of a business rather than one of a governmental nature, such as the supply of light or water or the operation of a railroad which is generally engaged in by individual or private corporations, it acts as such a corporation and not in its sovereign capacity."⁴

In spite of recent tendencies toward further activities of the federal government in the public utility business, President Roosevelt has been quoted as having said in a speech on Sept. 21, 1932, "I state to you categorically that as a broad general rule the development of utilities should remain, with certain exceptions, a function for private initiative and private capital."

5. a. With regard to the service rendered, or the possible services to be rendered, a wide variety of evidence might be presented. Cities *A* and *B*, having municipal ownership of utilities, are frequently quoted as having better or worse service, depending upon the location, the accounting methods used, the local fuel and labor supply, and the point of view or bias of the narrator, than cities *C* and *D* where the other type of utility is operating. Comparisons are frequently made between cities widely separated geographically or between those where natural resources and/or administrative methods vary greatly. Comparisons with foreign cities are frequently introduced into the argument. In the last analysis both may be mistaken in their respective judgments as in the case of the blind men who, having been brought into the presence of an elephant for the first time agreed that this new quadruped with both trunk and tail was able to travel equally well in either direction. It may be a safe suggestion that, if

the administration changes frequently and if interconnection with other sources of service from other cities is not available or if very large reserve capacity is not otherwise supplied, the possibility of irregular or interrupted service of an important utility may be more frequently experienced in the municipally controlled property.

"The [telephone] lines throughout France were so inefficient and unreliable, as government owned utilities usually are, that to provide unfailing connections it was necessary for us to put in much new construction along our channels of supply, from base ports to headquarters."

—GENERAL JOHN J. PERSHING.⁶

"Whenever government ownership is discussed, great emphasis is usually placed upon low rates. The fact that a higher quality of service is involved sometimes escapes attention. As an example: the difference in service between the federally owned railroads of France and Germany and the privately owned railroads of the United States is too well known to need a great deal of comment. The government railroads of New Zealand are notoriously poor in the quality of service they render. This is due largely to the fact that an effort is made to render service at a *low rate*."⁶

Conversely, it should again be emphasized, in all fairness, that conditions abroad are hardly an adequate criterion for this country, in times of peace, even though public operation was greatly curtailed here, as well as abroad, during the war.

Furthermore, the argument that better service in our local utilities results from holding-company control and interconnection is frequently used as an unjustifiably large cloak to cover many shortcomings when the subsidiary properties of such holding companies are scattered throughout the country and are in no sense physically interconnected and often are financially very inadequately interrelated with one another.

b. The rates charged for the service rendered, varied though it be, are also quoted throughout a wide range of values and in varying locations in both types of utilities. Fundamentally, if a privately owned utility can operate at a profit, as it should, of course, a similar profit might be waived by a municipally owned plant in favor of its owners, the public, and the rates *for the same service* reduced by the amount of the profit that might thus be waived. Furthermore, low rates of the latter plant are frequently made available, although hardly justified, by sub-

stituting taxes upon *all the populace* for the losses of the few. These two conditions, however, *assume equally good service to consumers* of both types of utility companies. The question arises: are these assumptions insured over a period of years of operation?

Rates in vogue with individual companies or in particular localities should not be used as conclusive arguments for or against public ownership of public utilities. However, averages throughout the country and census figures have some significance which the engineer executive as well as the public at large should take into consideration.

Private electric companies in the United States sell service for less than do municipalities. The average rate per kilowatt-hour sold to ultimate consumers for all private companies was 2.7 cts., while for the municipal utilities it was 3.1 cts. If allowance is made for taxes, the private utilities sold their electricity for 25 per cent less than the municipal utilities did. The rate per kilowatt-hour for private companies, after deducting taxes, was 2.4 cts., while the rate for the municipally owned electric utilities (not including taxes) was 3.0 cts.⁷

"Average rates for residence and commercial service are reported lower for the municipal utilities by the Census Bureau. It is generally known that municipal plants purposely set residence and commercial rates low to win that large class of customers to the side of municipal ownership. Low *residence rates* do not tell the story."⁸

c. Continuity of service involves either large reserve plant capacity to avoid interruptions due to breakdowns and to allow adequate repair and maintenance of equipment or it requires interconnection of generating stations in various cities by means of transmission lines which make available generating equipment from two or more sources in case of local failure or abnormal local demands for service. An alternative is the so-called breakdown or readiness-to-serve contract between municipal and near-by privately owned utilities for which a relatively large charge, whether the service is used or not, has been amply justified in many commission and court decisions. It requires no further argument to demonstrate the fact that municipal utilities are considerably more handicapped in rendering a high-grade continuity of service by reason of their inability to interconnect

and their tendency to limit capital expenditures for reserve capacity in order that their rates may be low.

Mr. Paul Jerome Raver in the *Journal of Land and Public Utility Economics* for May, 1933, indicates that 1,461 cities disposed of their municipal electric plants in eight years. One wonders why. Can it be that they were worn out and there was no money to replace them or can it be that they could not compete with the initiative and ingenuity of the private utilities?⁸

d. Closely related to the above (c) is the difficulty of adequately and economically serving the rural or suburban areas surrounding municipalities. Normally, the municipal utility can serve only within its corporate limits, although in some instances extensions beyond such limits have been provided by special legal enactments. If the municipality serves the cream or the most profitable portion of the consumer demand and leaves the suburban and thinly populated rural districts to the private utilities because only they have available interconnected networks of transmission and distribution systems in such areas, obviously the rates would have to be excessively high in such areas. Is this not an argument for state-owned public utilities or possibly federal-owned interstate utilities, particularly in areas where natural power resources are available? Why all the discussion devoted exclusively to municipal and federal ownership? Is there a place for the state in such a picture? Possibly the situation may be compared in part to the generally recognized economies, with possibly equally good service and possibly lower tax burdens, which might be rendered to various communities by the state with the elimination of county and township organizations. However, the difficulty of changing the constitution of a state, wherever such a plan has been discussed in legislative assemblies, has at once become obvious from the political standpoint. It is, however, a problem with which the oncoming generation of engineer executives must wrestle. Think it over carefully.

e. Can the dependability of personnel be relied upon in government-operated utilities? The engineer, usually an individual not politically inclined, enters a municipal utility with the expectation, based upon tradition and precedent, that such a position is necessarily temporary and possibly for the duration of

the present administration only. Such a short tenure of office and the usual lack of recognition of any meritorious service other than immediately lowered costs tend to discourage the employee from his best endeavors and/or cause him early to seek more nearly permanent employment with more adequate recognition. More specifically, can P.W.A. or C.C.C. labor ever be made to produce the desired service and take the great responsibilities coincident with continuous and adequate light and power supply? The reply is that the equivalent is being done in the municipal water-supply and in the fire- and police-protection services. But are these services necessarily as complicated and as technical as that of furnishing electric light and power? Recently in New York City an interruption to all electrical service occurred throughout several blocks of the uptown district, due to the failure of one high-tension cable. All lights were out in all buildings, cars were stalled on the surface and in the subway, elevators were stopped for hours between floors of hotels, and even the telephone service in some localities was either interrupted or so greatly overloaded as to be entirely inadequate. The remedy, not available even with expert help for several hours, was dependent upon the combined and immediate action of hundreds of trained engineers and other employees. Ask yourself the question, would this have been possible and, if so, how quickly would the situation have been cleared under municipal ownership and operation? No one knows, but it is good experience to plan it out for yourself if such operation is contemplated. What would you do?

"Government ownership takes from the people the greatest incentive to endeavor which has been the birthright of the American people and made us what we are."—WILLIAM S. LEE, late Past President of the American Institute of Electrical Engineers.⁹

"From an administrative point of view the peculiar difficulties of public management are that it tends to become slothful and careless. In order to make management accountable to the public it becomes hedged about with restraints which prevent comprehensive and far-sighted planning and executing these plans with vigor and effectiveness. The disciplinary conditions of employment may be undermined by a political nepotism which deadens the initiative of talented employees."—GLAESER.¹⁰

"With our form of government, whether federal, state, or municipal, we must have individual responsibility rather than legislative responsi-

bility. Without individual responsibility we cannot have business methods. That is why a government undertaking rarely gets through on the appropriation given it. *The personal relation to money is not present.* If a private corporation incurs debts that it cannot pay, it fails and the officers lose their jobs. But the government undertaking merely goes back to the trough for more money. There is a big difference, and whatever the theoretical savings we may plan for public ownership they are wiped out in practice by the *decrease in the efficiency of human beings.* Government operation in industrial service is a flat failure from a service-to-the-public standpoint, as well as from the standpoint of financial returns, which should have a bearing on the case for taxpayers."—EDWARD M. HURLEY, formerly head of the U. S. Shipping Board.¹¹

"The servants of the most negligent master are better superintended than the servants of the most negligent sovereign."—ADAM SMITH.¹²

On the other side of the question lie all the arguments and advantages, which are expected to accrue to the more widespread distribution of wealth and responsibility, if not to ultimate socialism or communism. That the extension of municipal ownership and operation is considered as an important step toward such an end is evidenced as follows:

"I am solid for government ownership because it is the first road to socialism. I am for state and municipal ownership because it is an easy way to get what we want."—EUGENE V. DEBS, Socialist candidate for President.¹³

"To begin with, the socialists seek first the key industries."—NORMAN THOMAS, Socialist candidate for President.¹⁴

"We [socialists] have made three attempts at control. *We have set up municipal plants.* Their status is changing and we should face that fact. Outside of the large cities they can no longer compete in rates and efficiency with the new plants being established by companies. . . . *We have tried regulation by state commissioners.* It has gotten out of hand. We cannot hope to take over the whole eight billion dollar industry successfully even if it were generally thought advisable to do so. . . . If we don't bite off more than we can chew, we may have a good deal to chew on in the coming years."—H. S. RAUSCHEREBUSH, in the *New Leader*, a New York socialist paper, Mar. 12, 1927.¹⁵

The solution therefore enters politics and exceeds the bounds of this text. The young engineer should, however, study both sides of this important question before entering either the privately owned or publicly owned utility business.

f. The accuracy of accounting of municipally owned public utilities has been frequently challenged. The accounting system of privately owned utilities is subject to state regulation with respect to standardization of method and annual reports.* Municipal plants in comparatively few states are under such regulation; hence the possibility of less rigorous financial procedure in the nonregulated cases. Losses due to abnormally low rates have often been neutralized from other municipal funds, thus requiring the taxpayer to shoulder burdens for which he may secure no direct service or return.

Only so late as Monday of this week, King County Superior Court directed that a verdict of \$3,500 for damages against the Municipal Street Railway System be paid out of the General Fund supported by taxation on every piece of taxable property in Seattle because the Railway System had no money to pay the judgment.

There is the first of the court precedents fastening the responsibility and liability of a municipal-ownership business venture on the General Fund.¹⁴

The U. S. Census Bureau (U. S. Census of Electric Industries, 1922) states:

The (financial) statistics of municipally operated public service enterprises are for the most part defective, in consequence of the fact that their accounts are not completely segregated, and the enterprises are not credited with all the revenues from their activities, *nor debited with all the expenses chargeable to them.*

It should further be pointed out that when the government (city, state, or federal) takes over a public utility, *they remove that public utility property from the tax rolls. . . .*

Eliminate the tax burden from our electric utilities in the United States and it would be possible to reduce rates approximately one-third.¹⁵

On the other side of the question it may be argued that these criticisms of accounting methods might be remedied by more nearly adequate state regulation of municipal utilities; furthermore, as the necessity of electric service becomes more general, as in the case of water supply, general taxation to provide financial losses therein may become more equitable; witness the

* See Chaps. XXVI and XXVII.

neutralization of postal department and other governmental losses by taxation.

6. Care should be exercised in quoting successes or failures elsewhere, particularly in the famous Ontario cases and in other foreign countries or distant states, as arguments pro or con for the municipal ownership of local utilities.

"It must be recognized that the peculiar social, economic, and political conditions of different countries make impossible the transplanting of institutions from one country to another with the expectation that they will operate with the same efficiency in all of them."¹⁶

The fact that Richmond, Ind., seems to have prospered with an enviable combination of low rates, good service, and adequate reserve equipment under municipal ownership, principally because of its well-trained, enthusiastic, and efficient personnel, does not prove that other cities, even of similar size and location, may fair equally favorably. Nor do the unfortunate experiences of the Detroit Municipal Railways, of Tacoma, Wash., with its municipal shortage of power which was temporarily relieved through the cooperation of the U. S. Navy, or of the obsolete plant of the Cleveland municipal electric utility necessarily provide exhibits opposing municipal utility undertakings in other localities, particularly if the latter may be protected by state regulation.

7. Why not make up the impending losses through taxation? Such a policy can, no doubt, be justified for street lighting, which corresponds in its value to water, police, and fire services for the entire community. Furthermore, when all taxpayers become consumers of necessity, as the use of electricity becomes more general, an approximation to the equity of the tax is approached. Unfortunately for equitable taxation, various classes of consumers are being served, such as rural, residential, commercial, power, and possibly railway demands. They are all served because of the varied nature of their demands at different rates and they contribute differently to such profits or losses as the utility may experience. Such losses can hardly be equalized among taxpayers. It was recently reported that the municipal lighting plant of the city of Peru, Ind., had had a very successful year (1936), in which certain buildings had been constructed and certain other municipal funds replenished from the profits of the

electric-lighting business. Should the consumers of electricity bear such expenses or should they be shared by the whole taxable constituency?

8. The impossibility of supplying adequate or reasonable rate service in suburban and rural districts by means of private transmission lines and distribution networks wherein the most profitable load is absorbed by municipal plants has already been demonstrated. The answer must be: (1) private utility service in both areas, (2) extension and interconnection of municipal transmission under state regulation, or (3) *state or federal ownership and operation* of such utilities.

9. No doubt state regulation of municipal utilities will help insofar as adequate rates, service, and accounting of municipal utilities are concerned, but such regulation alone will not solve the rural and suburban service problem which is daily becoming more of a claimant for the serious attention of legislators and utility executives.

10. To the extent that the superintendent, the engineer, and their employees must be of the persuasion of the administration, to the extent that the usual frequency of change of party in the administration obtains, to such extents will the lack of initiative and ambition to achieve and advance in the profession be a handicap to municipal utility operation. If, however, these important positions can be removed from political influence and the tenure of office extended, these vital weaknesses and unsafe operating conditions of municipal operation may be overcome. Referring only to safety and not to the impossibility of well-regulated continuity of service, after a serious breakdown in one city which resulted in an electrocution, a competent engineer was recommended. The suggestion was ignored because of the large salary required to secure and hold a man of adequate experience. Two more lawsuits, resulting from fires and fatalities within the next year, caused financial damages several times the recommended salary, not to mention the loss of prestige of the administration and the entire community.

Both sides of these questions have been presented. Facts and experience still seem to favor private ownership and operation in general, although many favorable locations may be cited wherein successful municipal and federal ownership and operation have flourished. You must be the judge in your community.

and for your consideration of an engineering and executive position for the future.

Specific References

1. COOLIDGE, CALVIN: "Address before Daughters of the American Revolution," Washington, Apr. 15, 1928.
2. LINCOLN, ABRAHAM: July 1, 1854, "Abraham Lincoln Complete Works."
3. *Logan City v. Logan Power and Light Company* (Utah 1927), P.U.R. 1928-B, 410, 429.
4. *City of Logansport v. Public Service Commission of Indiana*, Supreme Court of Indiana, July 1, 1931.
5. Edison Electric Institute, "Government Ownership of Public Utilities," *Publication S4*, 1936, p. 1, New York.
6. *Ibid.*, p. 7.
7. U. S. Census of Electric Industries for 1932; also Edison Electric Institute, "Government Ownership of Public Utilities," *Publication S4*, 1936, p. 1, New York.
8. *Ibid.*, p. 6.
9. *Ibid.*, p. 2.
10. GLAESER, MARTIN G.: "Outlines of Public Utility Economics," The Macmillan Company, New York.
11. NASH, L. R.: "Economics of Public Utilities," McGraw-Hill Book Company, Inc., New York.
12. See No. 5, p. 3.
13. *Ibid.*, p. 2.
14. SELVIN, EDWIN: *Seattle Business Chronicle*, Feb. 3, 1932; also *ibid.*, p. 5.
15. See No. 5, p. 7.
16. See No. 10, pp. 677, 678.

Review Questions

1. In what way does an unbiased understanding of the controversial question of public versus private ownership of public utilities assist the young engineer?
2. Under what conditions would a municipality be justified in the following actions:
 - a. Purchasing of an existing electric light plant and operating it itself.
 - b. Building a new plant and operating it, abandoning the old one.
 - c. Building a new plant and operating it in direct competition with an existing privately owned plant.
3. What are the factors that tend to classify a service as a public or a private function?
 4. Discuss the effect of competition on the advancement of an art.
 5. What is the fallacy in the argument that, because public operation of a utility is successful in *A* city, it will be equally successful in *B* city?
 6. Upon what basis may such comparisons as the above be logically made?

- 7.** Are the underlying problems involved in this question of public versus private ownership technical, economical, sociological, political, or a combination of several?
- 8.** Assuming that the technical problems are in a minority in Prob. 7, why should an engineer be concerned at all in the matter?
- 9.** In event of a general switch over from private to public operation of public utilities, what will be the function of state or federal regulatory bodies and commissions?
- 10.** Is a decision to build a municipal plant, based upon present conditions only, necessarily justifiable?

CHAPTER XXV

PUBLIC UTILITY REGULATION BY COMMISSIONS

Intimately bound up with the question of water power is that of effective public utility regulation. They both started out as pressing problems in our industrial and home life. Two years ago I urged upon the legislature of the state of New York the need of a fundamental change in our law concerning public utility corporations. The legislature set up a commission to study the subject. Both the majority and minority reports of that commission disclose the ineffectiveness of our present supervision over these corporations, though it is generally conceded that the Public Service Commission is now functioning more effectively insofar as authorized by our present statutes. Regulation of monopolies for centuries under common-law principles and under the theory of the original Public Service Commission Law was based upon the underlying principle that these utility companies should furnish fair service at reasonable rates. That purpose in many cases has been thwarted. In some cases rates are too high; profits are beyond any reasonable return on investment; service is not always satisfactory—the plain truth is that effective regulation as contemplated originally has not been realized.*

Thus speaks the Honorable Franklin D. Roosevelt as Governor of New York in one of his characteristic criticisms of present regulation and his commendation of state ownership of electric power utilities.

In sharp contrast with this attitude, to illustrate the divergence of public opinion regarding this controversial subject of public utility regulation, will be found the following quotation from the Honorable Louis L. Emmerson, Governor of Illinois, in the same publication:

In all of the agitation at Washington aimed at the electric power industry, the rank and file of the people, in my opinion, are interested from only two standpoints: they want a service that is adequate and a management that is progressive in its provisions for future needs.

* ROOSEVELT, FRANKLIN D., "Utility Operation—A Yardstick," *Elec. Light and Power*, June, 1931, p. 27.

They want to be sure that rates for service are reasonable and that the profit taken by the industry on the capital investment is not exorbitant. *They do not care who owns the power properties or who operates them, so long as they meet these two fundamental tests.*

Under private ownership regulated by governmental commissions, the electric power industry has developed within a few years until it supplies every center of population in the United States with light and power, representing a total investment of eleven billions of dollars. It is not likely that there will be any general movement in favor of a change from private to public ownership so long as the people are satisfied that, as a regulated monopoly, the power industry is giving them good service at a reasonable cost.

Almost every state in the Union has some form of regulatory body empowered to decide on rates and service of public utilities. *The laws are ample upon this subject.* The administration of the laws, however, depends upon individuals and the people are not always so sure that these individuals are not influenced to the detriment of public welfare.

Under proper regulation the power industry can earn only a reasonable return on the investment. Generally speaking, this return is not more than 8 per cent. Good management and a reasonable return will result in reasonable rates to the consumer.

As a matter of fact, the rates for electricity are lower today than they were prior to the war, in spite of the fact that wages and taxes are twice as high now as they were then. This tends to indicate that regulation on the whole has been honest and fair.

One of the objectives sought at Washington by certain interests is national regulation of power companies whose distributing lines extend from one state to another. Interconnection of sources of power is one of the important developments of the industry in recent years. It has many advantages over the old system of separate power plants in each community, making it possible to supply power at lower cost of production and with greater dependability. Small towns which paid a high rate for a poor quality of service have now, because of interconnection of power plants, the advantages of continuous and reasonably priced service that are enjoyed by larger cities. This should be encouraged, rather than discouraged.

The tendency of the national government has been constantly to increase its control over local or state functions, and this effort at national regulation of power companies is but another step in that direction. State regulation has proved successful and there seems to be no adequate reason for national control of rates and service of electric power companies.

Naturally, in an industry of such diverse ownership and management as the electric utilities, there is much that can be criticized justly. The power companies must recognize this fact frankly and keep their own house in order, if they expect to retain the public good will. It is highly important that they cooperate in every way possible with public regulatory bodies and avoid anything that has even the appearance of an improper attempt to influence these commissions.

Under existing conditions the public utility is a regulated monopoly. The public gives it protection from ruinous competition and thus affords suitable return on its investment. This creates a direct obligation on the utility to give the best quality of service at the lowest possible price. Failure to accept this responsibility with a full sense of its importance will result in the total loss of public good will.

If the electric utilities are satisfied with reasonable returns on their investments, if their managements continue to be alert to provide adequate and efficient service, and if they are honest in their dealings with public regulatory bodies, they have nothing to fear from government, either national or state. As long as they retain the good will of the public, they will be permitted to control the industry.

On the other hand, if they lose public good will, and to the extent that they lose it, they will be deprived of control over this important utility.*

Utilities in the early days were regulated by competition as private nonmonopolistic business has always been controlled more or less automatically. The old law of "supply and demand," with its reactive effects upon prices, may be depended upon fairly consistently where competition prevails. The duplication of facilities, if and when possible, in a utility field frequently not large or rich enough to support more than one company, has usually resulted ultimately in the consolidation of parallel services, involving, in turn, higher rates. This outcome, requiring the consumer to pay the excess cost, although frequently repeated in different sections of the country, was grasped slowly by the public mind and is not yet generally understood by the public at large. Regulation of public utilities by means of competition, therefore, has failed.

By means of special charters issued by the state and franchises and ordinances issued by the local governments to these new public service corporations, an attempt was made to anticipate

* EMMERSON, LOUIS L., Governor of Illinois, "Only a Problem of Service," *Elec. Light and Power*, June, 1931.

every possible issue between the public and the corporation and to provide for their solution in advance. Such charters and special privilege grants, bolstered by the common law, offered the only early regulation. This was done for the reason that the courts alone, and not the legislature, had the sole jurisdiction over the corporation. Appeal to the courts from an abused charter privilege was the only recourse of the public. The issuance of increasingly specialized charters and the constant necessity of their interpretation, however, soon led to the belief that regulation might be accomplished better by more direct methods.

The state legislatures then began to delegate to the municipalities control over utilities within their corporate limits. However, courts could not lay down conditions for future guidance but could only adjudicate, very slowly at best, controversies that had already proved unduly irritating.

Local control of the utilities by the municipal government was given a fair trial and is still being tried, in a supplementary fashion, in some of the larger cities, even where state regulation also has been provided. This experiment in home rule, although undertaken upon a very large and varied scale, has been, in general, very disappointing. The outcome of most of such experimental regulation has been most concisely stated as follows by Judge Owen of the Wisconsin Supreme Court:

The relations existing between the respective municipality and their public utilities were most unsatisfactory. The impotency of the municipalities to deal with them so as to secure adequate and satisfactory service for reasonable charges was abundantly demonstrated. The officers of the municipalities lacked the training in the technique of the public utility business which was essential either to protect the interests of the citizens or deal justly with the public utility company. Whether the relations between the municipality and the utility company were that of open war or supine acquiescence on the part of the city to the demands of the company mattered little to the consumer. Unreasonable demands made by the city as a result of a lack of information concerning the public utility business were as fruitless of just results as meek submission to the ultimatums of the utility. The situation resulted neither in justice to the consumer nor stable business conditions to the utility. So it was determined to take from the municipalities, which were not equipped to fix standards of service which might reasonably be demanded under the circumstances and determine reasonable

rates therefor, the regulation and control of public utilities, and vest the power with the Railroad Commission, which body, through its staff of experts, could acquire the information necessary to fix and enforce appropriate standards of service and just and reasonable rates which should adequately compensate the utility for the service rendered. The legislation has been welcomed by the public and public utility companies alike.*

The additional objections to municipal regulation were:

1. Regulation usually took the form of a long-term contract or franchise made by one administration and questioned by another.
2. Such ordinances, often stipulating rates over long periods, were too inflexible and not readily adaptable to changing local conditions.
3. Municipal contracts, frequently including free service to the municipality, took the form of inequitable taxation involving discrimination against certain groups of taxpayers.
4. Burdens of paving, maintenance of streets, free service, etc., forced upon the public utility company in return for a franchise or in the form of regulatory ordinances, often reacted upon the helpless consumer in the form of higher rates.
5. Governing boards of municipalities were so frequently interlocked with the boards of the local utilities that the necessary rigid regulation failed to materialize.
6. Utilities operating in several municipalities and municipal plants desiring to extend service beyond their corporate limits could not readily provide equitable service and rates.
7. A municipality is itself a consumer of public utility service. It always represents not only itself but all other consumers in any controversy with a public utility. Manifestly, a party to a dispute can never be as fair a judge of the merits of his own case as an outsider with no interests involved.

Such failures and delays in municipal and court regulation led to the suggestion of direct legislative control. Various states then created administrative regulating boards which acted as agents of the legislature more or less directly in the attempt to regulate utilities.

* *Superior Water Light and Power Co. v. City of Superior*, 174 Wis. 257, 181 N.W. 113.

In the so-called Granger Cases in 1876, which attracted so much favorable attention as a possible solution of the utility regulation problem, it was held by the U. S. Supreme Court that various states might create boards to regulate maximum rates and to prosecute violations of rate rulings. Many such boards were quickly formed, with their jurisdiction extended to express, transportation, telephone, and telegraph companies.

Direct regulation by the legislature, however, was found by experience to be too slow and arbitrary, failing to provide the necessary analysis of special cases, and securing results scarcely more favorable to the parties concerned than regulation by the municipality. Therefore the creation by the legislature of commissions which should specialize in regulation and devote all their time to this problem of ever-increasing importance is a movement that has spread among the various states very rapidly and, in general, has resulted very favorably.

As the result of many years of experience, it is now generally recognized that the regulation of public utilities by commissions, established under vigorous legislative enactments of the states in which they are located, is not only necessary but mutually advantageous to the public and to the public service corporation alike. Although such regulatory power on the part of the state was first applied to railroads and later to other common carriers, it was finally extended to practically all public service enterprises, including local utilities, and in many states even to the municipal light, power, and water plants.

Although some slight variations exist in the methods of appointment and the authority of public service commissions now active in nearly every state in the Union, the status of the Public Service Commission of Indiana, which was established as the result of the Shively-Spencer Utilities Commission Act of the 1913 Indiana Legislature, will suffice as a typical illustration of such regulation. This is particularly true since this act was almost an exact duplicate of the pioneer law established by the Wisconsin legislature in 1907, which has been followed in considerable detail by many other states.

Although much discussion has arisen regarding the definition of a public utility, as indicated in Chap. XXIII, this fact does not cloud the issue as to the jurisdiction of the commission,

since the enterprises that the commission may regulate are very definitely set forth as follows:

That the term "public utility" as used in this act shall mean and embrace every corporation, company, individual, association of individuals, their lessees, trustees, or receivers appointed by any court whatsoever, and every city or town, that now or hereafter may own, operate, manage, or control any street railway or interurban railway or any plant or equipment within the state for the conveyance of telegraph or telephone messages, or for the production, transmission, delivery, or furnishing of heat, light, water, or power, or for the furnishing of elevator or warehouse service, either directly or indirectly, to or for the public.*

Subsequently the bus utilities have been placed under the public service commissions of Indiana and several other states.

This commission consists of five members appointed by the governor, not more than three of whom shall be of the same political party. Their term of service is four years. The commission is authorized, with the advice and consent of the governor, to employ the necessary counsel, engineers, accountants, and clerks. Under this provision an engineering department has been established to provide appraisals and necessary engineering estimates and advice, to set up and maintain proper service standards, and to prepare statistical engineering evidence for commission and court hearings.

Since the law provides for appeal to the courts from the decision of the commission, the hearings before the commission necessarily take the form of court trials with customary representation of both sides by counsel, the legal introduction of testimony, the possible subpoena of witnesses, etc.

The principal activities of the public utility commission of any state, illustrated by quotations from the Indiana law, are as follows:

1. Regulation of Rates Charged by Utilities.—Perhaps the most important function of a state regulatory commission is that of determining a fair rate of return to be allowed the utility for rendering its service to the public. Such a rate of return, a part of which provides the dividends to its stockholders, must be sufficiently high to attract new capital to the enterprise and to

* Legislative Acts (Ind.), 1913, Ch. 76, p. 167, BRS Sec. 10052.

provide adequately for operating expenses, fixed charges, maintenance, and depreciation. Its determination involves rates, valuation, gross revenue, etc., the making of appraisals by the engineering department, the careful study of the books of the utility by the accounting department, and finally a detailed analysis by the members of the commission itself, calling forth the mature judgment and long experience of experts. The problem is far from solved, however, when the fair rate of return upon the investment or present value has been determined, for the distribution of such gross revenue between the various classes of service and the relative equitable charges to be made for large and small consumers having different types and magnitudes of demand involve a still more careful analysis and delicate adjustment.

The act with respect to the regulatory powers of the Indiana commission over public utility rates reads as follows:

Whenever, upon an investigation, the commission shall find any rates, tolls, charges, schedules, or joint rate or rates to be unjust, unreasonable, insufficient, or unjustly discriminatory or to be preferential, or otherwise in violation of any of the provisions of this act, the commission shall determine and by order fix just and reasonable rates, tolls, charges, schedules, or joint rates to be imposed, observed, and followed in the future in lieu of those found to be unjust, unreasonable, insufficient, or unjustly discriminatory or preferential or otherwise in violation of any of the provisions of this act.

2. Maintenance of Service Standards.—The commission is expected to establish and maintain certain standards of service. Wisconsin has established a rather more complete set of standards, together with an experienced personnel for their maintenance, than most of the other states. A large staff of technically trained inspectors, provided with portable test instruments, is maintained throughout the state at all times for the purpose of checking the service rendered by the various utilities. Partial illustrations of such requirements are listed as meter accuracy, voltage at the consumers' premises, gas pressure and heating value, water pressure, railway seating capacity, rapidity of telephone connections, street lighting, etc.

3. Control of Public Utility Capitalization.—Although the extent to which commissions in the various states may control

the issue of stocks and bonds is subject to considerable variation, partly because of the fact that some states have corporation commissions for the purpose of independently regulating the capitalization of all corporations *including* public utility corporations, yet, as an example, the Indiana regulation will be listed:

Sec. 88. No public utility shall hereafter issue for any purposes connected with or relating to any part of its business, any stocks, certificates of stock, bonds, notes, or other evidences of indebtedness, payable at periods of more than twelve months, to any amount exceeding that which may from time to time be reasonably necessary, determined as herein provided, for the purpose for which such issue of stock, certificates of stock, bonds, notes, or other evidences of indebtedness may be authorized.*

This and following sections contemplate that securities should be substantially equal to investment, and without guaranteeing securities the state should make such securities safe investments.†

This and following sections, while contemplating the protection of investors, do not contemplate that the development of legitimate public utility enterprises in new and undeveloped fields, such as central power stations, should be hampered.‡

This and following sections are in addition to and do not supplant the general incorporation laws of the state. The approval of the commission is not necessary before the Secretary of State may issue a certificate of incorporation, nor is such approval necessary for the resolutions, minutes, and proceedings of a corporation required by law in order to increase its capital stock before the same are filed with the Secretary of State. *But before any issue of stock is actually made,* the approval of the commission must be obtained.§

Sec. 89. No public utility shall issue any stock or certificate of stock, except in consideration of money or of labor or of property at its true money value as found and determined by the commission actually received by it. No stock or certificate of stock shall be sold at a discount or premium without the approval of the commission, and, if sold at a discount, the commission shall make a record thereof and give such publicity of the fact as it may deem necessary, at the expense of the utility. No public utility shall issue any bonds, notes, or other evidences of indebtedness, except for money or labor or property estimated at its true money value as found and determined by the

* Legislative Acts (Ind.), 1913, Ch. 76, p. 167.

† *Re Indiana Power & Water Co.*, No. 4358, decided Mar. 15, 1919.

‡ *Ibid.*

§ Opinion of Attorney-General Honan, May 17, 1913, Report, p. 109.

commission actually received by it equal to a sum to be approved by the commission not less than seventy-five per cent (75%) of the face value thereof.*

This section contemplates that stockholders shall have a real financial interest and equity in the property of a public utility.†

In requiring that there shall be a reasonable proportion between stock and bonds, the intent of the legislature was to require the owners of utility properties to retain an equity in their properties, and thus to safeguard without guaranteeing the interests of investors in public utility securities.‡

This provision contemplates that the stockholders shall have a real financial investment, interest, and equity in said plants, and that such utilities shall be removed from the field of speculative and blue-sky investment.§

Considering all of the elements included in the portion of Sec. 89, . . . above quoted, the commission is of the opinion that the authorization of \$300,000 of additional bonds, thereby placing the bonded indebtedness \$360,000 in excess of the value of the petitioner's property, would create a condition in which the 'amount of bonds' would not 'bear a reasonable proportion to the amount of stock,' . . . due consideration being given to the business in which the petitioner is engaged. Its credit would be imperiled if not entirely lost, and its future prospects dark. Its life would be endangered; its earnings practically nothing; its management and efficient operation adversely affected by reason of the relative amount of financial interest of the stockholders in the corporation being practically nil.¶

Sec. 90. A public utility as defined in section one (1) of this act may, with the approval of the commission, issue stock, certificates of stock, bonds, notes, or other evidence of indebtedness payable at periods of more than twelve (12) months after the date thereof, when necessary for the acquisition of property, the construction, completion, extension, or improvement of its facilities, plant, or distributing system, or for the improvement of its service, or for the discharge of lawful refunding of its obligations, or for the reimbursement of moneys actually expended from income, or for any other moneys in the treasury of the public utility for such purposes, not secured or obtained from the issue of stocks, bonds, notes, or other evidences of indebtedness of such public utility within five (5) years next prior to the filing of an application

* *Ibid.*

† *Re Indiana Power & Water Co.*, No. 4358, decided Mar. 15, 1919.

‡ *Re New Albany Waterworks*, No. 4324, decided Apr. 29, 1919.

§ *Re Indiana Power & Water Co.*, No. 3700, decided Mar. 25, 1918.

¶ *Re United Gas & Electric Co.*, No. 3597, decided Apr. 17, 1918.

with the commission for the required authorization for any of the aforesaid purposes, in cases where the applicant shall have kept his accounts and vouchers of such expenditure in such manner as to enable the commission to ascertain the amount of moneys so expended and the purposes for which such expenditure was made.*

Although other details of procedure are outlined in the act, the previous quotations should be adequate to establish the regulatory powers of the commission with respect to the issuance of securities. One interpretation of the law by Attorney-General Stansbury, on July 10, 1917, to the effect that "the commission has power to authorize an Indiana public service corporation to issue securities for the purchase of the capital stock of a public utility in another state,"† is rather significant in connection with questions to be discussed hereafter, with respect to the limited regulatory powers of state commissions over utilities operating in other states and the resultant need of federal regulation to solve such problems.

4. Accounting Methods.—Adequate comparisons of rates charged by public utilities for service and their resulting return, expressed as a percentage of approved valuation or capitalization, can be made by the regulating commission only after standardized accounting methods have been established. The law provides, therefore, that the commission shall require certain standards of accounting of the public utility companies and that reports expressing a variety of unit costs of service based upon such standard books of account shall be filed with the commission annually. Furthermore, accounting forms, initiated by the commission, are required so that all accounts and methods of charging and crediting such detailed transactions shall be similarly and systematically recorded by all public utility corporations operating within the state.

Previous to the era of regulation by the state commission, many public utilities kept their books of account in a very unsatisfactory manner. This was especially true of the smaller properties and the municipal plants. Accounts of the water and lighting business of the latter were often hopelessly confused with one another and with the other branches of the municipality.

* Legislative Acts (Ind.), 1913, Ch. 76.

† *Ibid.*

In some few instances accounts were changed, even destroyed or carried to another state just previous to a pending rate investigation. In other cases, in which accounts were available for inspection, the portions of lighting and power receipts resulting from private consumers as contrasted with municipal services were very frequently hopelessly involved. Municipal utilities in one political administration would suffer financial losses from their operation requiring that such deficits be made up from taxes, while excess profits in other administrations would provide new municipal buildings and other capital for the city which would be far removed from the business of the utility itself.* This, of course, was a reflection of excessively high rates. Consumers of utility service were paying for municipal improvements that should have been provided only by taxation.

Standardized accounting methods, which are outlined more in detail in Chaps. XVI and XXVI, and which are frequently checked by the public service commission, have greatly improved this condition and have at least allocated expenditures, sometimes excessive in amount, to the proper accounts.

5. Elimination of Competition.—One of the most salutary features of commission regulation has been the avoidance of duplicate systems of utility service which were formerly in competition with one another in the same community. Once the principle of regulated monopoly for public utility service has been adopted, such business should, of course, be granted a complete monopoly. High rates resulting from duplicate power plants, distribution systems, and communication agencies, however necessary for competition, must be eliminated or else paid for by someone. The consumer must ultimately bear such a burden.

The inauguration of the so-called "indeterminate permit," defined by this regulatory act of the legislature,† offered the much-needed relief from duplication of plant and competition. Its definition is as follows:

Sec. 97. No license, permit, or franchise shall be granted to any person, copartnership, or corporation to own, operate, manage, or control any plant or equipment of any public utility in any municipality

* See also Chap. XXIV on Municipal Ownership.

† Legislative Acts (Ind.) 1913, Ch. 76.

where there is in operation a public utility engaged in similar service under a license, franchise, or permit without first securing from the commission a declaration, after a public hearing of all parties interested, that public convenience and necessity require such second public utility. Any existing permit, license, or franchise which shall contain any term whatsoever interfering with the existence of a second public utility is hereby declared to be against public policy and is hereby amended in such manner as to permit a municipality to grant a license, franchise, or permit for the operation of such second public utility pursuant to the provisions of this act.

Sec. 98. No municipality shall hereafter construct any such plant or equipment where there is in operation in such municipality a public utility engaged in similar service under an indeterminate permit as provided in this act without first securing from the commission a declaration, after a public hearing of all parties interested, that public convenience and necessity require such municipal utility. But nothing in this section shall be construed as preventing a municipality acquiring any existing plant by purchase or by condemnation as hereinafter provided.

Sec. 100. Every license, permit, or franchise hereafter granted to any public utility shall have the effect of an indeterminate permit subject to the provision that the license, franchise, or permit may be revoked by the commission for cause or that the municipality in which the major part of its property is situated may purchase the property of such public utility actually used and useful for the convenience of the public at any time as provided herein, paying therefor the then value of such property as determined by the commission and according to the terms and conditions fixed by said commission, subject to all the provisions as to hearings and appeals set out in Secs. 105 and 106 hereof. Any such municipality is authorized to purchase such property and every such utility is required to sell such property at the value and according to the terms and conditions determined by the commission as herein provided. . . .

6. Hearing and Adjusting Complaints.—Having established and protected such a monopoly from competition, the consumer and the public must have provisions for the hearing and adjustment of complaints. These usually take a form similar to that quoted from the Indiana law:

Sec. 57. Upon a complaint made against any public utility by any merchantile, agricultural, or manufacturing society or by any body politic or municipal organization or by ten persons, firms, corporations,

or associations, or ten complainants of all or any of the aforementioned classes, or by any public utility, the rates, tolls, charges, or schedules or any joint rate or rates in which such petitioner is directly interested are in any respect unreasonable or unjustly discriminatory, or that any regulation, measurement, practice, or act whatsoever affecting or relating to the service of any public utility or any service in connection therewith is in any respect unreasonable, unsafe, insufficient, or unjustly discriminatory or that any service is inadequate or cannot be obtained, the commission shall proceed, with or without notice, to make such investigation as it may deem necessary or convenient. But no order affecting said rates, toll charges, schedules, regulations, measurements, practice, or act complained of shall be entered by the commission without a formal public hearing.

Provisions are made subsequently in the legislative act for public hearings, the presentation of evidence in accordance with court procedure, reports by the various departments of the commission regarding the complaint, defense by the utility, etc., before a decision is rendered by the commission.

Furthermore, since the law provides for injunction or appeal through the courts in connection with any decision of the commission, the entire procedure throughout such a hearing and the acts of the commission acquire the technique and legal aspects of the courts; the latter provide a stabilizing agency for any otherwise superficial or inequitable consideration or decision.

The Need for Uniform Laws for State Regulation.—Such are the examples of more rigorous regulation of public utilities established in certain states at the present time, of which the laws of Indiana and Wisconsin commissions are typical. Of course, some state commissions are more rigorous in their regulation than others. Some may favor the utility, others the consumer or municipality, to a greater extent. Policies and the rigor of disciplinary measures fluctuate somewhat with state administrations and their various appointees to positions upon their respective commissions.

Recently, with the extensive development of holding companies which are frequently incorporated in some state distant from that of their subsidiary operating companies but which have financial policies, operating technique, and frequently rate theories dictated from without, the problem of adequate regulation by the state has become a more and more difficult one.

Directed toward the same difficulties have been the policies resulting in the grouping of local services into comprehensive networks of transmission and communication, overstepping state boundaries and yet providing, in general, far more efficient operation and more dependable service for an ever-increasing group of consumers. How shall holding-company operation of public utilities be regulated? May interstate power transmission and finance be adequately controlled in the interests of the individual consumer or of the municipality or state by some federal commission without federal ownership or without serious impairment of the present fairly satisfactory solution of the problem within the individual states? Such are the live questions with which this chapter was opened, expressed in quotations from authorities diametrically opposed to one another. The age-old question of "states rights" appears, therefore, in a new garb.

That this policy of regulation is far from standardized, however, is evident from the following excerpt:

We are dealing with an industry intimately and inextricably bound up in the industrial and social life of the country. It represents a capitalization of close to fifteen billion dollars. The industry is basic and essential to all the people. It is an industry, too, where all of the profits are now limited and can no longer be subjected to the evils of exorbitant profits too often prevalent in its early history. . . .

As has been recognized, state regulation of some public utilities has been generally adopted in one form or another but we do not believe that investment bankers and investors understand what lack of uniformity exists in the practice of regulation with respect to both privately and municipally owned utilities.

As to privately owned plants, we find of the forty-eight states and the District of Columbia that only twenty-five commissions have authority in matters of valuation, rates, services, and capitalization.

It is further observed that, while about three-quarters of the states require of privately owned properties their financial reports of operation, and that such reports are open to public inspection, probably less than half of these reports are actually published. We believe that the public and investors are entitled to this information.

Your committee does not believe the best operating results can be attained by the industry until the commissions have such broad authority, exercise it judiciously and regularly, and publish full financial reports of operations.

Furthermore, in the opinion of your committee, money cannot be steadily raised at reasonable costs until the country more fully attains this result.

The industry is at a point today, through the development of the central steam station, improved methods of high-tension transmission, and the development of water power, where it has long ceased to be a local business confined to the corporate limits of a municipality. It is, in fact, leaping state boundaries. Sections of the states of North Carolina, South Carolina, Georgia, Alabama, and Tennessee for some time have been connected by high-tension transmissions. There exists a great network of transmission lines interconnecting at many points in the states of Ohio, Michigan, Indiana, Illinois, Wisconsin, Iowa, and Minnesota. The states of Montana, Washington, and, especially, California, have developed high-tension transmission to a marked extent. Natural "super-power zones" under private capital and management are actually being developed. Thus we see today the natural resources (either fuel or water power) of districts often made available for the constant daily needs of distant communities lacking them. High-tension transmission has developed flexibility, reliability, and a "readiness to serve" to such an extent that we look on electric power as indispensable. With a growing industry still requiring large sums of new capital from year to year for some time, it is essential from an investment-banking point of view, alone, that the laws for the regulation of the public utilities by states be broader and more uniform than at present.

It is equally important that the administration of the laws by the commissions be confined to the matters which shall protect the public interests and that there be reserved to private capital those matters of management properly belonging to it. The Supreme Court of the United States (*The State of Missouri ex rel. Southwestern Bell Telephone Company, plaintiff in error v. Public Service Commission of Missouri, etc.*) May 21, 1923, said:

"It must never be forgotten that, while the state may regulate with a view to enforcing reasonable rates and charges, it is not the owner of the property of public utility companies and is not clothed with the general power of management incident to ownership. The applicable general rule is well expressed in *State Public Utilities Commission ex rel. Springfield v. Springfield Gas and Electric Company*, 291 Ill., 209, 234.

"The commission is not the financial manager of the corporation and it is not empowered to substitute its judgment for that of the directors of the corporation; nor can it ignore items charged by the utility as operating expenses unless there is an abuse of discretion in that regard by the corporate officers (see *Interstate Commerce Commission v. Chicago*

Great Western Railway Co., 209 U.S., 108; *Chicago, Milwaukee & St. Paul Railway Co. v. Wisconsin*, 238 U.S., 491; *People ex rel. v. Stevens*, 197 N.Y., I.)"

Your Committee recommends therefore that members of this association urge, wherever lacking, that the state commissions be vested with authority over the valuation, rates, services, and capitalization of privately owned plants and that there be required and published full financial reports of operation.

An examination of the summary Table of the Jurisdiction and Powers of State Public Service Commissions will disclose a surprising lack of authority over those utilities which are municipally owned and operated. We find only ten state commissions where jurisdiction extends over rates, services, and accounting. Users of service and, especially, taxpayers are entitled to know what are the costs of utility service on a basis of accounting standard to the industry and not according to any antiquated or inadequate system of accounts such as too often are used by municipal authority. As members of this association, purchasers of securities of privately owned plants and obligations of municipalities, we have an equally keen interest in this aspect of municipal operation. Your committee's study this year has observed instances of improper bookkeeping, unsound financial or engineering methods with respect to publicly owned properties both in this country and Canada. Too often has such procedure resulted in serious financial losses, *after those responsible therefor have gone out of office and cannot be held properly accountable*. It seems to your committee essential that voters of communities which are in the utility business should be more actively educated to a point where public opinion will require proper accounting and sound methods of engineering, finance, and operation.*

Many feel that the pendulum has reached the end of its swing in the direction of too strict regulation. Shall we look for another cycle of "history repeating itself" during the next generation? If such a change does take place in the direction of less stringent regulation of our utilities, as was the case in the early days of the nineteenth century, it will probably result directly from the following causes:

1. Demands from consumers and regulating bodies for better and more varied service at existing or lower rates.
2. Inability of utilities to meet these demands with a fair profit under strict regulation.

* Excerpt from the Annual Report of the Committee on Public Service Securities of the Investment Bankers Association of America, in *Twelfth Annual Proceedings*, 1923, pp. 116-124.

3. Dissatisfaction with commission regulation for the reason that too much was expected of it by the public.
4. Dissatisfaction with commission regulation for the reason that such regulating bodies are too often made up of men not experienced in the engineering and financial problems of the utility.
5. Difficulty in obtaining desired results through regulation because of an attempt to apply radical though theoretically correct methods to utility management in the immediate future.

That the demands of consumers for better and more varied service from public utilities at existing or lower rates have been most urgent during the last two decades will not be questioned. The public does not wish more light alone, but more light with the same or lower monthly bill. This was clearly proved with the introduction of the tungsten lamp. It is a significant fact that the cost of electrical energy to the consumer is one of the few, if not the only, household expense that has not increased during the recent period of high cost of living. This was made possible as a result of great improvements in generating equipment and in the consolidation of small power plants into group networks supplied from large and more economical central stations.

With these economies in the cost of energy at the switchboard, however, it has been a difficult problem for utilities, particularly in small communities, to show a creditable balance sheet at the end of the year. It must be remembered that the cost of energy is but a small percentage of the gross cost of delivering good service at the consumer's residence. Furthermore, many of the small utilities have given little or no attention to depreciation reserves until forced to do so by a commission. Capital has been increased to meet demands for equipment replacements with little or no limitation. Elaborate accounting systems have been avoided wherever possible in the attempt to reduce expenses.

Now enter strict commission regulation upon such a setting as has been described. Innovations, however desirable in the ultimate regulation, should not be introduced too rapidly. Many admirable requirements for utilities have been cast into disrepute by both officials and consumers as a result of too-hasty enforcement. The practice of making a capital charge for replacements, instead of setting aside a depreciation sinking fund over a period of years to take care of the replacement when

it becomes necessary, has been considered legitimate finance for years. It is too much to expect a corporation to adjust itself to the new restrictions immediately, particularly when a reserve fund is opened and capital increase curtailed just previous to the necessary replacement of some large unit of generating equipment. Finance not only authorized but generally approved today should not be stamped as a crime tomorrow without an intervening period in which the utility may regain its poise and adjust itself to the proposed conditions. In a word, the public and many of the commissions have expected this new physician to effect an immediate cure for a chronic malady. A delay in such a cure need not and should not result in too-hasty condemnation of both physician and method of treatment.

It is not to be inferred that the physician of the above analogue is always the proper specialist to treat the disease in question. More than one profession is necessary to effect the cure of this patient, but all the specialists with the necessary training are too seldom summoned for the final consultation. Reference is made, of course, to the domination of public utility commissions by lawyers and politicians to the exclusion of engineers. The problem, if it is to be satisfactorily solved, should have the combined talent of the legal and engineering professions. That such is not the case, particularly in the Middle West, is partly due to the inactivity of the engineers. Engineers, largely because such a condition has been tolerated, are looked upon either as academic scientists destined only to discover and state abstruse fundamental laws for the other professions and for the man of the street to use or not as suits his practical whim, or as a kind of animated slide rule or calculating machine designed to tabulate inventories, valuations, and rate schedules for others to apply. Our neighbors and colleagues have not learned, largely because we have not forced upon their attention, the fact that Tredgold a century ago defined engineering as an "art" and not a pure science. There are more possibilities for the human element, the personal equation, and the use of good sound judgment in the opinions and decisions of the engineer than we are likely to insist upon injecting into the regulation of public utilities.

If regulation of public service by commission has not proved to be a panacea for all ills to which the public utility is heir, this

fact may be attributed in part to an attempt in many instances to apply certain theoretical rules and methods to all problems of regulation, large and small, regardless of local environment and the status of the balance sheet. The tendency to load the books of utilities with expensive detailed appraisals before a slight change of rates or a bond issue can be effected is one example of such a difficulty. Appraisals seem to be infectious and the contagion spreads rapidly. One made by the commission begets one by the utility. The interests of the municipality must be protected by a third. In many instances a fourth or fifth must be undertaken by unbiased parties to check those which have gone before. When all is done in great detail with a high degree of accuracy, the intangible values must be estimated as a result of experience and sound engineering judgment exercised by experts. These added values may justly represent a considerable percentage of the detailed appraisal. They involve the "art" as well as the science of the profession, and yet the engineers are criticized when their opinions differ and their conclusions cannot be given to the third decimal place.

Opposition to appraisals is not implied. They are absolutely necessary in many rate decisions. They must be interpreted and amplified, however, by experts in any event. Let us not shoulder the interested parties with such expensive detailed studies. The public must pay the cost in the long run. Engineers will be called upon both sides of the case. Why not put some dependence upon their judgment and trust to the hearing to bring out the fair adjustment.

The Massachusetts commission began its period of education way back in the eighties. It has taken over two scores of years, in many instances, to bring about the theoretical ideal in regulation without hardship to consumer or stockholder.

If, therefore, there seems to be a state of unrest at present in the evolution of public utility regulation, let us not jump too quickly to the conclusion that the pendulum must necessarily swing again to the other extreme, but let us be sufficiently conservative in our analysis of the problem. It has been said that "A new broom sweeps clean." Possibly it may wear itself out in the process, and the floor as well, but it must be remembered that no broom at all leaves one in a much more deplorable confusion and chaos. It is probable that properly regulated

monopoly has come to stay for our public utilities as a happy mean between cutthroat competition with duplicate systems, for which the consumer has to pay in the long run, and governmental ownership, which is bound to be inefficient, generally speaking, because of its dependence upon political prestige. Whether this feeling is general or not, let us at least give regulation a reasonable time in which to put its principles into practice to best advantage. Engineers have a real part to play in the success or failure of either solution of this very vital problem.

Federal Regulation of Public Utilities.—Although the Federal Interstate Commerce Commission has been regulating the interstate activities of railroads and other communication systems for many years, the Federal Power Act,* which applies to the federal regulation of interstate power transmission, the public utility companies engaged therein, and the water-power developments, is of comparatively recent origin.

The Federal Power Act was originally enacted as the Federal Water Power Act, approved June 10, 1920 (41 Stat. 1063, 16 U.S.C. 791-823). On Mar. 3, 1921, it was amended to exclude therefrom any authority to license water-power projects in national parks or national monuments (41 Stat. 1353). The commission was reorganized as an independent commission under the act approved June 23, 1930 (46 Stat. 797). By Title II of the Public Utility Act of 1935, approved Aug. 26, 1935, the original Federal Water Power Act was made Part I of the Federal Power Act and Parts II and III added to that act. Part II vests in the commission jurisdiction over the interstate transmission of electric energy and public utility companies engaged therein. Part III relates to such companies and to licensees, and carries the administrative and procedural provisions of the Federal Power Act.

The Federal Power Commission which was created by this act in 1930 is

. . . composed of five commissioners appointed by the President, by and with the advice and consent of the Senate. . . . Not more than three of the commissioners shall be appointed from the same political party. No person in the employ of or holding any official relation to any licensee or to any person, firm, association, or corporation engaged in the generation, transmission, distribution, or sale of power, or owning stock or bonds thereof, or who is in any manner pecuniarily interested

* Available at U. S. Government Printing Office, Washington, D. C.

therein, shall enter upon the duties of or hold the office of commissioner. Said commissioners shall not engage in any other business.

The features of this act which are of value to the engineer and public utility executive are abstracted here with:

- Sec. 4.** This commission is hereby authorized and empowered to:
- a. Investigate, etc., water resources, power industry, etc.; use of government dams, etc.
 - b. Consider detailed statements of cost of construction, etc., to be furnished by licensees.
 - c. Cooperate with federal or state agencies in investigations.
 - d. Publish information; report to Congress.
 - e. Issue licenses for improving navigation, developing water power, etc.; approval of dams, etc., on navigable waters.
 - f. Issue preliminary permits to applicants.
 - g. Investigate occupancy, etc., of lands, streams, etc., under jurisdiction of Congress; to issue orders in public interest.

Sec. 7. Provide for development of water resources for public purposes by the United States.

- Sec. 10.** Licenses issued by the commission provide for the following:
- a. Project adapted to utilize navigation, water power, etc.
 - b. Project works to be maintained in effective operation, etc.; liability for damages to property of others.
 - c. Amortization reserves to be established; rate of return to be specified in license.
 - e. Basis of annual charges and rates to consumers to be fixed; no charge to states if power is furnished without profit.
 - f. Payment by licensee if benefited by work of another or for benefit by government construction. . . .
 - h. Combinations in restraint of trade, etc., in electric service output are prohibited.

Sec. 14. Provision is made for the United States, upon not less than two years' notice in writing and upon or at the expiration of any license to take over, maintain, and operate any project included in such license, or to take over upon mutual agreement with the licensee property for the development, transmission, and distribution of power. It is to pay the net investment of the licensee, not to exceed the fair value plus such reasonable damages as may be caused. These values are to be determined by the commission after notice and opportunity for hearing.

The right is reserved for the United States or any state or municipality to take over, maintain, and operate any project licensed under this act at any time by condemnation proceedings upon payment of just compensation.

Sec. 19. Provides for relations between federal and state regulation.

Sec. 20. Reasonable rates are provided for power used in interstate commerce; discriminatory rates are declared unlawful and provisions are made for enforcement if no authority is provided by the states.

Procedure of this commission is to conform as far as applicable with practice of the Interstate Commerce Commission.

Sec. 26. Equity proceedings provided for revoking licenses; district courts have jurisdiction; court may sell the project; vendee to take the rights and assume the obligations of licensee.

Sec. 27. State laws are not affected.

Part II. Regulation of Electric Utility Companies Engaged in Interstate Commerce

Sec. 201:

- a. Federal regulation is declared, if there is no state provision therefore, upon the transmission and sale of electrical energy in interstate commerce and the sale of such energy at wholesale in interstate commerce.
- b. It shall not apply to any other sale of electrical energy or deprive a state or state commission of its lawful authority over the exportation of hydroelectric energy which is transmitted across a state line. It shall not have jurisdiction, except as specifically provided, over facilities used for the generation of electric energy or over facilities used in local distribution or only for the transmission of electric energy in intrastate commerce, or over facilities for the transmission of electric energy consumed wholly by the transmitter.
- c. Interstate transmission, wholesale sale of energy, and public utility are defined.

Sec. 202. Interconnection and coordination of facilities, the terms under which such are established, emergencies and transmission to foreign countries defined; conservation of natural resources provided; regional districts established in cooperation with states. Interconnection may be ordered by the commission, but it cannot compel enlargement of generating facilities. Exportation of electric energy to a foreign country, without permission of the commission, is prohibited.

Sec. 203. Disposal, merger, or consolidation of facilities is prohibited unless specifically approved by the commission; acquisition of securities of public utilities is prohibited unless specifically approved.

Sec. 204. Issuance of securities or assumption of liability by a utility is prohibited unless authorized.

No public utility shall, without the consent of the commission, apply any security or any proceeds thereof to any purpose not specified in the commission's order, or to any purpose in excess of the amount allowed for such purposes.

Capitalization of rights in excess of amount paid therefor is prohibited. "In case of securities having no par value, the par value for the purpose of this subsection shall be the fair market value as of the date of issue."

Provisions of this section are not applicable where states regulate securities. Securities are not guaranteed by the United States.

Sec. 205. All rates, rules, and regulations not just and reasonable shall be unlawful; no undue preference or advantage to any person or any unreasonable difference in rates or service shall be provided.

Rates, rules, and regulations shall be reported to the commission and open to public inspection; changes in schedules are prohibited, except after thirty days' notice to the commission and to the public. In rate hearings, the burden of proof is upon the utility.

Sec. 206. The commission, upon its own motion or upon complaint, may determine reasonable rates and investigate cost of production and transmission.

Sec. 207. After a hearing, it may fix rates and service, provided: "That the commission shall have no authority to compel the enlargement of generating facilities for such purposes, nor to compel the public utility to sell or exchange energy, when to do so would impair its ability to render adequate service to its customers."

Sec. 208. The commission is authorized to ascertain actual legitimate cost of property and depreciation thereon, the inventory and statement of original cost to be filed with the commission by the utility.

Sec. 209. Use of joint boards and cooperation with state commissions.

Part III. Licensees and Public Utilities; Procedural and Administrative Provisions

Sec. 301. Licensees and public utilities shall make, keep, and preserve accounts, records, etc., but are not relieved from keeping such required by state laws. Commission may prescribe a system of accounts. Burden of proof to justify accounting entries is on person making the entry. Commission may suspend charges and credits. It shall have access to and right to inspect accounts, records, etc. Licensees and utilities are to furnish the commission with information in the matter of contracts, engineering reports, etc., but no member of the commission shall divulge any fact or information except insofar as he may be directed by the commission or by a court.

Sec. 302. Commission may require licensees and public utilities to carry a depreciation account and determine and fix the rate of depreciation. Such depreciation shall not be charged to operating expenses unless authorized. An opportunity shall be given to state commissions to present views and recommendations.

Sec. 304. Reports shall be filed with the commission, the form and contents of the reports to be prescribed by the commission. Such reports shall include, among other things, "full information as to assets and liabilities, capitalization, net investment, and reduction thereof, gross receipts, interest due and paid, depreciation, and other reserves, cost of project and other facilities, cost of maintenance and operation of the project and other facilities, cost of renewals and replacement of the project works and other facilities, depreciation, generation, transmission, distribution, delivery, use, and sale of electric energy. The commission may require any such person to make adequate provision for currently determining such costs and other facts."

Sec. 305. It shall be unlawful for officers or directors to benefit from sale or issuance of securities. Dividends shall not be paid from funds included in capital accounts. "It shall be unlawful for any person to hold the position of officer or director of more than one public utility or to hold the position of officer or director of a public utility and the position of officer or director of any bank, trust company, banking association, or firm that is authorized by law to underwrite or participate in the marketing of securities of a public utility, or officer or director of any company supplying electrical equipment to such public utility, unless the holding of such positions shall have been authorized by order of the commission, upon due showing in form and manner prescribed by the commission, that neither public nor private interests will be adversely affected thereby."

Sec. 307. "Any person who willfully shall fail or refuse to answer any lawful inquiry or to produce correspondence, memoranda, contracts, agreements, if in his or its power so to do, in obedience to the subpoena, shall be guilty of a misdemeanor and, upon conviction, shall be subject to a fine of not more than \$1,000 or to imprisonment for a term of not more than one year, or both."

No person is excused from testifying, etc., before the commission on the ground that his testimony may tend to incriminate him. No person shall be prosecuted if he is compelled to testify or produce evidence. No exemption from prosecution for perjury.

Sec. 313. Rehearings; Court Review of Orders.—Application for rehearing shall set forth grounds upon which it is based. Commission may grant or deny application. Application is automatically denied unless commission takes action within 30 days. Only objections urged before the commission shall be considered by the court. Findings of fact supported by substantial evidence are conclusive. Additional evidence may be adduced *before the commission* upon leave of the court. Commission may modify its findings by reason of such evidence.

Sec. 314. Enforcement of Act, Regulations and Orders.—Violations of provisions of this act, or of rules, regulations, or orders thereunder may be enjoined by action in district court. Attorney-General may be requested to institute criminal proceedings. District courts, upon application by the commission, may issue writs of mandamus commanding persons to comply with the act or rules and orders.

Sec. 315. General Forfeiture Provision.—*a.* “Any licensee or public utility which willfully fails, within the time prescribed by the commission, to comply with any order of the commission, to file any report required under this act or any rule or regulation of the commission thereunder, to submit any information or document required by the commission in the course of an investigation conducted under this act, or to appear by an officer or agent at any hearing or investigation in response to a subpoena issued under this act, shall forfeit to the United States an amount not exceeding \$1,000 to be fixed by the commission after notice and opportunity for hearing. The imposition or payment of any such forfeiture shall not bar or affect any penalty prescribed in this act but such forfeiture shall be in addition to any such penalty.”

Sec. 316. General Penalties; Venue.—Willful violation of act punishable by fine or imprisonment or both.

Sec. 317. Jurisdiction of Offenses; Enforcement of Liabilities and Duties.

Sec. 318. Conflict of Jurisdiction.

Review Questions

81.

In the following questions the title “public service commission” is used to designate the governmental body of a state which has regulatory powers over utilities of that state.

What important regulatory powers has the public service commission

Sec. 306 over public utilities?
A public utility company is considered by some consumers to be preserve ~~and~~ high rates. Indicate all the possible procedures that might be undertaken to investigate and remedy any such condition if established.

3. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

- T F A state commission may now regulate interstate activities of holding companies.
- T F The gas pressure to be maintained by a gas utility company may be specified and regulated by the state public service commission.
- T F Privately owned utilities in this state are now protected against municipal ownership by the indeterminate permit.
- T F There is no appeal from the decision of the state public service commission.
- T F Both natural and artificial monopolies among the public utilities are regulated by a state commission.
- T F Municipally owned public utilities have the additional handicap of a state tax in this state.

T F The public service commission may determine the value of a public utility corporation to be a figure quite different from its previously issued capitalization.

T F A public utility may refuse to serve some applicants for a reasonable service which it is able to provide.

T F An indeterminate permit gives the right to a public utility to operate free from regulation.

T F The indeterminate permit takes the place of a charter.

4. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

T F There is more need of public ownership of electric-power supply than of water supply.

T F The indeterminate permit is a protection of the public utility against competition.

T F Regulation of rates should have the individual city network rather than the interconnected utility system as the basis of determination.

T F Utilities should have state or federal rather than municipal regulation.

T F In this state the utilities' own accountant has complete authority over the books of his own company.

T F Utilities in this state may issue additional stock without commission approval.

T F Adequate regulation of holding companies can be provided only by a federal agency.

T F As the result of court appeal, many objectionable features of commission regulation may be neutralized.

T F Watt-hour meter accuracy within 0.5 per cent is just^{as} commission regulation.

T F Utilities may be purchased by municipal government.

5. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

T F A public utility corporation is regulated by a commission and is a monopoly.

T F A municipal power plant is subject to the regulation of the commission in this state.

T F The public service commission has the power to regulate utility officials.

T F The indeterminate permit in this state grants franchises.

T F A bond issue of a public utility cannot be issued without permission of the regulatory commission.

T F A ruling by a public utility commission is a final one if the public utility involved.

T F A public utility would be required by the commission to have a motor generator set in a large office building to generate the power if the building management desired that service.

T F The indeterminate permit gives the right to a public utility to operate the service of a utility operating within that city if the utility desires.

T F A warehouse is ordinarily classed as a public utility.

- T F The public service commission has the power to regulate the issues of public utility stocks and bonds.
6. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:
- T F Company A, which furnishes gas in containers by trucks to farmers, is not generally considered a public utility.
- T F Company B, which furnishes heat through pipes to a large number of office buildings and stores, is generally considered to be a public utility.
- T F The owner of a high office building in a town where there are no other high buildings installs a roof garden and then complains to the public service commission that the water pressure is unsatisfactory. The commission is correct in ruling that the owner will have to install his own pressure system.
- T F In a certain section natural gas was mixed with artificial gas and used for cooking. A number of consumers complained to the public service commission that the mixed gas did not burn properly in their stoves, which were designed for operation on artificial gas. An investigation showed grounds for this complaint. The commission had the right to force the gas company to improve the quality of the gas service.
- T F Rulings of the public service commission are absolutely final.

7. The state public utility commission has regulatory powers over each of the following utilities and functions of utilities. Answer Yes or No.

- preser _____ a. Municipal electric companies.
undertake _____ b. Wholesale drugstores.
place a circle around the letter T or F according to whether you _____ c. Interurban motor-bus lines.
under each _____ d. Meat-packing corporations.
preser _____ e. Grain elevators.
undertake _____ f. Water pressure maintained by water companies.
place a circle around the letter T or F according to whether you _____ g. Capitalization of utilities.
undertake _____ h. Personnel of directors of utilities.
place a circle around the letter T or F according to whether you _____ i. Accounting methods of utilities.
undertake _____ j. Voltage regulation of utilities.

8. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

- for each franchise granted to a public utility by a municipality may have _____ a valuation which will be recognized by a commission as a legitimate base.
- public utility may vary a rate schedule of a group of consumers without approval by the regulatory commission.
- ation approved by a commission may differ from that which the utility has actually invested.
- T's of the public service commission may be appealed to the courts.
- company operates a system in a certain city under an indefinite permit. However, the city decides to operate its own bus

system and requests the commission to set a proper price, which is done. The bus company then must sell whether it wishes to or not.

- T F Some holding companies may be regulated by state commissions.
T F "Franchise" and "indeterminate permit" are synonymous terms.
T F Public utilities have always been subject to some form of commission regulation.
T F A public utility is protected against competition by the public service commission.

- T F A public service commission may regulate the variation of frequency supplied to consumers by a light and power public service company.

9. Place a circle around the letter T or F according to whether you consider each of the following statements to be true or false, respectively:

- T F The public service commission has regulatory powers over the gas pressure maintained by gas companies.
T F The public service commission has regulatory powers over chain stores.
T F Public utility corporations in this state may issue more stock without the consent of the public service commission.
T F State regulation affords unsatisfactory regulations of interstate transmission of power.
T F Regulation of holding companies by the public service commission is difficult.
T F The public service commission has the right to restrict both the amount and kind of securities issued by a public utility.
T F The indeterminate permit was originally introduced to take the place of the corporate charter in the case of public utilities.
T F The average citizen seldom considers all the technical, economical, and social phases of the public utility regulation problem.
T F If all the public utilities in the state were municipally owned and not interconnected, there would be less need of the public service commission.
T F The members of the public utility commission of this state may own public utility stock.

10. A group of five men decide to promote an electric light and power utility in this state. They choose the corporate form of organization.

- a. Why is this better than a partnership for this type of enterprise?
- b. They obtain a charter and an indeterminate permit. Why are both needed and from whom is each obtained?
- c. Name a number of the most important items of regulation to which they will be subjected.

After ten years of operation they sell the control of their company to the Consumers Light and Power Company of another state, a holding company of the better sort.

- d. What control does the public service commission of this state have over this holding company?
- e. What advantages might result to the consumers of the original utility from such a transaction?

CHAPTER XXVI

PUBLIC SERVICE CORPORATION ACCOUNTING

The accounts usually required of public utility corporations by the various state and federal regulatory commissions have already been mentioned. The loose-leaf multiple journal, ledger, recapitulation ledger, and voucher systems are almost universally adopted with greater detail and more subsidiary accounts specified for the utilities in the larger cities than are considered

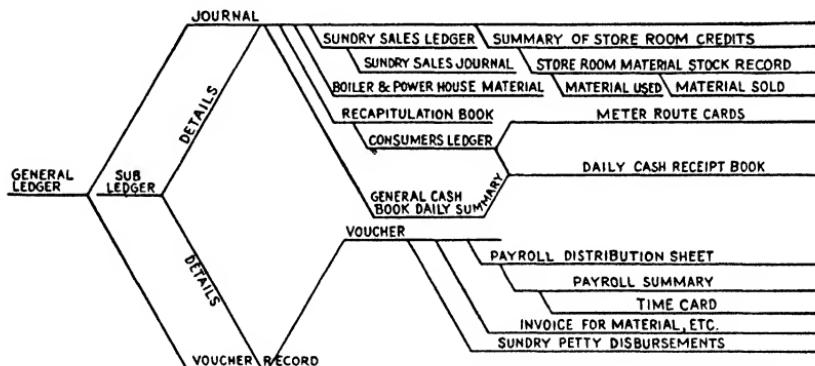


FIG. 40.—Voucher system required by the Indiana Public Service Commission.

necessary for the small companies. Some special features of public utility accounts, which otherwise fundamentally follow the theories previously stated for double-entry bookkeeping, may be briefly stated as follows:

1. Accounts involve relatively larger permanent investment in equipment with infrequent turnover of capital.
2. Many small short-time accounts receivable of a similar nature are required, which involve many individual entries.
3. Very little is involved in materials or merchandising.
4. Notes payable and other borrowed money items are likely to be relatively large.
5. Large reserve funds are necessary (required by the commissions) for bond amortization and depreciation.

6. Expenses must be allocated into many special classes with appropriate group account numbers (see accompanying Table LIII for the detailed accounts leading to the pay roll).

7. Gross revenues and profits are limited by commission regulation (see Chaps. XX and XXV).

8. The voucher system is usually required as the most convenient type of journal.

As an illustration of the convergence of various journal, voucher, and ledger accounts into the control ledger of a public utility corporation, the chart, Fig. 40, p. 530, of the Indiana Public Service Commission will be found of value as typical of many such systems.

TABLE LIII
Electric
Daily Time Card
Class B

Date _____ 19____

Name _____

Account Hours	number	Nature of work
<i>Power-plant Labor</i>		
500		Superintendent, power plant.
500		Draftsman or clerical help, power plant.
500		Foreman, power plant.
500		Engineer, power plant.
500		Oilers, wipers, machinists, power plant.
500		Electrical labor at plant, generator and switchboard attendants, brush men, electrical wipers, etc.
500		Cleaning power-plant buildings and yards.
500		Watchman at power plant.
505		Repairing steam engines and turbines.
505		Repairing steam power-plant auxiliary equipment, condensers, vacuum pumps, oiling systems, shafting, belting, motors, hoists, rope and cable drives, etc.

TABLE LIII.—*Continued*
 Electric
 Daily Time Card
 Class B

Date _____ 19_____
 Name _____

Hours	Account number	Nature of work
505		Repairing generators and alternators.
505		Repairing rotaries, motor-generator sets, excitors, etc., not used in connection with transmission system.
505		Repairing busbars, regulators, cables, switchboards, circuit breakers, switches, ammeters, voltmeters, etc.
505		Repairing high-tension transmission equipment at power plant.
507		Repairing power-plant buildings, fixtures, and grounds.
		<i>Boiler-house Labor</i>
541		Repairing boiler-plant buildings, fixtures, and grounds.
539		Repairing furnaces, boilers, stokers, grates.
539		Repairing coal- and ash-handling equipment.
534		Superintendent, boiler house.
534		Foreman, boiler house.
534		Fireman and helpers, boiler house.
534		Handling coal and ashes.
534		Cleaning boilers, blowing flues.
534		Watchman at boiler plant.
686		Coal, weighing, unloading, piling, and trimming.
		<i>Transmission and Transformation</i>
557		Inspecting, patrolling, testing, transmission system.

TABLE LIII.—Continued

Electric

Daily Time Card

Class B

Date _____ 19____

Name _____

Hours	Account number	Nature of work
	558	All substation and transformer-station labor, except repairs.
	561	Repairs to transmission system.
	563	Repairs to substation and transformer-station equipment.
	565	Repairs to substation and transformer-station buildings, fixtures, and grounds.
		<i>Distribution</i>
	576	Meters, removing and resetting.
	576	Meters, inspecting and testing.
	583	Meters, repairing, painting, readjusting and cleaning.
	583	Meters, changing for routine tests.
	576	Transformers, inspecting, removing, resetting.
	581	Transformers, repairing, oiling, repainting.
	579	Services, renewals or repairs.
	579	Commercial distribution lines, repairing or renewing lines, line poles, and pole equipment.
		<i>Consumption</i>
	586	Commercial lamps, trimming and inspecting.
	586	Commercial lamps, patrolling circuit.
	593	Commercial lamps, removing and repairing.
	593	Commercial lamp poles, replacing, renewing, repainting, straightening.

TABLE LIII.—*Continued*
 Electric
 Daily Time Card
 Class B

Date _____ 19_____
 Name _____

Hours	Account number	Nature of work
	595	Municipal contract lamps, trimming and inspecting.
	595	Municipal contract lamps, patrolling circuit.
	600	Municipal contract lamps, removing and repairing.
	600	Commercial contract lamp poles, replacing, renewing, repainting, straightening.
	591	Customers' premises expense, free wiring.
	591	Meters, changing for request tests.
	591	Inspecting and testing house wiring and fixtures.
	591	Repairing, wiring, and fixtures, free.
	591	Attention to complaints beyond meter inside building.
	591	Investigating large electric bills.
	591	Cleaning and repairing appliances on customers' premises.
	604	<i>Commercial</i> Reading meters or delivering bills.
	604	Collecting.
	606	Soliciting, demonstrating, distributing circulars.
	631	<i>Undistributed</i> Drivers, chauffeurs, etc.
	633	Repairing trucks, wagons, harness, etc.
	625	Work in stock room and storage yards.

TABLE LIII.—Continued
 Electric
 Daily Time Card
 Class B

Date _____ 19_____
 Name _____

Hours	Account number	Nature of work
<i>Construction</i>		
655		Commercial distribution lines, extending lines, setting line poles and pole equipment and stringing wire.
655		Commercial distribution lines, making new service connections.
657		Transformers, first installation.
659		Setting meters, first installation.
661		Commercial lamps, first installation.
663		Municipal contract lamps, first installation.
<i>Non-operating Revenues</i>		
763		House or store wiring, when charged for.
761		Assembling, wiring, delivering, and installing fixtures, lamps, fans, motors, and other electrical appliances sold by the company.
763		Setting and disconnecting motors and appliances owned by customers, when charged for.

Although there are some minor differences in the standardized accounting systems of the Federal Interstate Commerce Commission, the National Association of Railway and Utilities Commissioners, and the various state commissions, yet the forms and rules illustrated herein, which are required by the Indiana Public Service Commission, are typical of the majority and will indicate adequately the vast amount of statistical data, as well as the actual accounts, which are available in the reports that must be made annually by the various public utilities to the commission. While the smaller public utility companies are not required to follow in complete detail the rather elaborate account-

ing methods necessary for the large urban systems, yet the following rule of the Indiana commission, considered in conjunction with the outline of the requirements of the annual report, will demonstrate the fact that even the smaller utility companies must establish much more rigorous and complete accounting procedure than is usually practiced by the companies doing only a private business.

"It is further ordered that all electric utilities exercising their option . . . shall keep its records in such a manner so as to be able to readily compile the data called for in the annual report forms which have been used in the past."¹

The principal requirements of this annual report for Class A utilities of Indiana, exclusive of all detailed subheadings that are not necessary for the understanding of the subject matter, are listed briefly below. This outline not only describes very concisely the subdivision of accounts, but it tends to enlighten the reader in regard to the information which is required of a public service corporation and which is available to the interested public in the office of the commission.

"Annual reports must cover the entire calender year, beginning Jan. 1 and ending with the close of business Dec. 31. They should be filled out, duly verified, and returned to the office of the Public Service Commission of Indiana, Indianapolis, Ind., by Mar. 10, following the close of the year for which the report is made."²

They include the following:

FACTS PERTAINING TO CONTROL OF RESPONDENT³

1. Date of last meeting of stockholders for election of directors.
2. Total number of stockholders in attendance at last meeting.
3. Has each share of stock one vote? If otherwise, explain voting rights.
4. Has any issue of securities contingent voting rights? If so, explain character of such rights.
5. Has any issue of securities special privileges in the election of directors? If so, explain character of such privileges.
6. Did any corporation or corporations have control of respondent during period covered by this report? If control was so held, state: (a) the form of control, whether sole or joint; (b) the name and address of the controlling corporation or corporations; (c) the manner in which the control was established; (d) the extent of control.

7. Names and addresses of like utilities in same territory in competition with the utility making this report.
8. Have you installed and are you using the uniform system of accounting as prescribed by the Public Service Commission of Indiana?
9. Was plant installed or purchased by present owner? If purchased, state from whom purchased and date.

HISTORY OF COMPANY

1. "Full title of utility (private or municipal)."
2. Period covered by this report.
3. Location of plant.
4. Location of principal office.
5. Date when company was incorporated. Under laws of what state?
6. Date of reorganization or consolidation.
7. Name and location of any utilities purchased, or of which control was acquired, during year.
8. Date when company (or municipality) first began to sell electricity.
9. Names of cities and towns supplied with electricity.
10. Population of territory supplied.
11. Name of owning, controlling, or operating corporation.
12. Names of corporations owned, controlled, or operated.
13. What public service, if any, other than the sale of electricity, does this plant furnish?
14. Names of cities and towns included in this report in which respondent sells direct to consumers.
15. List of directors, municipal officers, or names of owners.
16. List of officers."

Income Account.†—The outline of the totals of subsequent accounts which may appear in the income account and of the proper sequence for entering them is provided with a reference to the line and page from which the total of the account is to be transcribed.

In place of the exact form used in the report, the more complete form, showing the sequence of the deductions, is reproduced as follows:¹

* Contrary to the law of some states, the municipally owned public utilities, by recent legislative act, are regulated and taxed by the state of Indiana.

† See Chaps. XVI and XXI.

STANDARD FORM OF INCOME ACCOUNT

Subject to variations to meet the requirements of the report forms of the
 Public Service Commission
 (Subdivided from various departments and totalizers)

Item Account

<i>Income from Operating Properties</i>		
1 401	Operating revenues.....	*** \$
2 402	Operating expenses.....	\$ ***
3 403	Uncollectible bills.....	***
4 404	Taxes	***
5	Total revenue deductions.....	***
6	Operating income applicable to corporate and leased properties	*** \$
7 411	Rent for lease of other electric plant.....	\$ ***
8 412	Amortization of limited-term landrights.....	***
9	Total (items 7 and 8).....	\$ ***
10 413	Rent accrued from lease of electric plant—Cr.....	***
11	Net rent deduction (credit balance in red).....	***
12	Balance of income applicable to corporate property	*** \$
<i>Income from Nonoperating Properties</i>		
13 421	Miscellaneous rent fevenues.....	\$ ***
14 422	Interest on long-term debt owned.....	***
15 423	Miscellaneous interest revenues.....	***
16 424	Dividend revenues.....	***
17 425	Income from special funds.....	***
18 426	Miscellaneous nonoperating revenues.....	***
19	Total (items 13 to 18, inclusive).....	\$ ***
20 427	Nonoperating revenue deductions.....	***
21	Total miscellaneous income.....	***
22	Gross corporate income (items 12 and 21).....	*** \$
<i>Deductions from Gross Corporate Income</i>		
23 431	Interest on long-term debt.....	\$ ***
24 432	Miscellaneous interest deductions.....	***
25 433	Amortization of debt discount and expense.....	***
26 434	Amortization of premium on debt—Cr.....	***
27 435	Miscellaneous amortization chargeable to income.....	***
28 436	Miscellaneous deductions from gross corporate income.....	***
29	Total deductions from gross corporate income..	***
30	Net income (loss in red).....	*** \$

STANDARD FORM OF INCOME ACCOUNT.—Continued

Item Account

<i>Disposition of Net Income</i>			
31	441	Sinking-fund appropriations.....	\$ ***
32	442	Dividend appropriations of income.....	***
33	443	Miscellaneous appropriations of net income.....	***
34		Total appropriations of net income.....	***
35		Balance transferred to surplus.....	*** \$

OPERATING REVENUE ACCOUNTS

Sales of current:

- 601. Metered sales to general consumers.
 - a. Residence lighting.
 - b. Commercial lighting.
 - c. Commercial power.
 - d. Combination light and power.
 - e. Other sales—metered.
- 602. Flat-rate sales to general consumers.
 - a. Residence lighting.
 - b. Commercial lighting.
 - c. Commercial power.
- 603. Railroad corporations.
- 604. Other electrical corporations.
- 605. Municipal street lighting.
- 606. Miscellaneous municipal sales.

Miscellaneous revenue:

- 611. Commissions on others' electric energy.
- 612. Rent from electric appliances.
- 613. Rent from property used in operation.
- 614. Merchandise and jobbing.
- 615. Miscellaneous operating revenues.

The following tables, including table values and units per kilowatt-hour, show merely the titles of the annual report tabulations, for which many subdivisions are specified in great detail:

Table Number

- 1 Commercial Lighting Earnings.
- 2 Municipal Contract Lighting Earnings.
- 3 Commercial Power Earnings.
- 4 Municipal Power Earnings.
- 5 Sales of Electric Current to Other Public Utilities.
- 6 Miscellaneous Earnings from Operation.

Table Number

- 7 Nonoperating Revenues.
- 8 Operating Expenses.
 - I. Production.
 - II. Transmission.
 - III. Distribution.
 - IV. Utilization.
 - V. Commercial Expenses.
 - VI. New Business Expenses.
 - VII. General Miscellaneous Expenses.
- 9 Steam Generation Apportionment Account.
- 10 Contingencies.
- 11 Depreciation.*

Note: Explain here in detail the basis upon which the deduction from revenues on account of depreciation, as shown in the Income Account, is founded, and also the method by which the amount in question was derived. State specifically whether the deduction is designed to cover the total estimated depreciation for the year of all the depreciable property of the plant. If the amount deducted can be so divided as to show separately the estimated depreciation for the different classes of property as buildings, apparatus, distribution equipment, etc., such divisions should be made. The amount here deducted will be carried to the Depreciation Reserve.

12 Taxes.

Totals for the following governmental units and † apportionment to various departments are involved.

- a. State, county, and local taxes.
- b. Federal taxes.
- c. Income.
- d. Undistributed net income.
- e. Capital stock.
- f. Tax-free securities.

Describe basis upon which apportionment was made in case more than one utility service is furnished.

13 Depreciation Reserve Account.‡

Balance from earlier report, transfers and disbursements for reconstruction, replacement, construction, additions, and extensions are listed in detail.

14 Sinking-fund Account.§

Balances, transfers, and disbursements, as well as apportionment to various departments, are required with description of basis upon which apportionment was made.

15 and 16 Reserve Accounts (Various Reserves Defined and Listed).

* See also Chap. X.

† See Chap. XVIII.

‡ See also Chaps. X and XVI.

§ See also Chaps. X and XIV.

Table Number

- 17 Corporate Surplus or Deficit Account.
Balance carried to side of balance sheet.
- 18 Fuel Account.
Types used and inventory of each.
- 19 Cost of Plant and Equipment.
Perpetual inventory of all subdivisions and totals including: (a) cost at beginning of year; (b) additions during year; (c) cost at close of year.
- 20 Capital Stock.
Classified as to preferred and common stock. Also (a) number of shares authorized; (b) par value of shares; (c) total par value authorized; (d) total amount issued and outstanding; (e) dividends declared (rate and amount).
- 21 Mortgage Indebtedness.
- 22 Funded Indebtedness.
- 23 Investment of Funds.
Sinking fund, depreciation reserve fund, miscellaneous funds, their income and amount.
- 24 Treasury Investments.
Stocks and bonds of other corporations owned, their par value, rate of income, income received, and valuation.
- 25 Balance Sheet.*
The importance of the balance sheet is such as to warrant the outline of the standard form prescribed in some detail with reference account numbers:

Standard Form of Balance Sheet
ASSETS AND OTHER DEBITS

101. Fixed capital.

Current Assets

111. Cash.
112. Notes receivable.
113. Accounts receivable.
114. Interest and dividends receivable.
115. Marketable securities.
116. Materials and supplies.
117. Prepayments.
118. Subscribers to capital stock.
119. Miscellaneous current assets.

Miscellaneous Assets

121. Investments in affiliated companies.
122. Miscellaneous investments.
123. Sinking funds.
124. Replacement fund.

* See also Chaps. XVI and XIX.

Standard Form of Balance Sheet.—Continued

- 125. Miscellaneous special funds.
- 126. Special deposits.

Suspense

- 131. Unamortized debt discount and expense.
- 132. Property abandoned.
- 133. Jobbing accounts.
- 134. Clearing or apportionment accounts.
- 135. Work in progress.
- 136. Miscellaneous suspense.

Adjustment Accounts

- 141. Discount on capital stock.
- 142. Reacquired securities.
- 143. Treasury securities.
- 150. Profit and loss—deficit.

LIABILITIES AND OTHER CREDITS

- 201. Capital stock.
- 202. Premium on capital stock.
- 203. Capital stock subscribed.
- 211. Long term debt.
- 212. Receiver's certificates.

Current Liabilities

- 221. Notes payable.
- 222. Accounts payable.
- 223. Consumer's deposits.
- 224. Matured interest unpaid.
- 225. Dividends declared.
- 226. Matured long term debt unpaid.
- 227. Miscellaneous current liabilities.

Accrued Liabilities

- 231. Taxes accrued.
- 232. Interest accrued.
- 233. Miscellaneous accrued liabilities.
- 241. Advances from affiliated companies.

Reserves

- 251. Retirement reserve.
- 252. Casualty and insurance reserve.
- 253. Unamortized premium on debt.

Standard Form of Balance Sheet.—Continued**Table Number**

- 254. Sinking-fund reserves.
- 255. Contribution for extensions.
- 256. Contingency reserve.
- 257. Miscellaneous reserves.
- 261. Miscellaneous unadjusted credits.
- 270. Profit and loss—surplus.

These balance-sheet items in the annual report are subdivided for each of the departments of the utility corporation such as electric, gas, heating, water, etc., and the totals are then summarized.

The remainder of the tables of the annual report are of a statistical character and are of value as a concise record of totals and as horsepower or kilowatt unit values for comparison with other similar corporations.

- 26 Central-station Equipment.
Engines, boilers, generators, transformers, etc.
- 27 Substation and Transformer-station Equipment.
- 28 Meters.
- 29 Distribution Transformers.
- 30 Electric Energy Account.
Classification of current generated, sold, lost and unaccounted for.
- 31 Detailed Statistics by Departments.
Maximum demands, fuel and water used and their unit costs, purchased energy, monthly station outputs, demand factor, load factor, etc.
- 32 Itemized Expenses per Unit.
“Unit cost, calculated from the items set forth in the following table, are specifically called for by statute. They should be figured carefully and checked over to eliminate clerical errors before the report is filed with the public service commission.
“The unit costs called for in the last column are the ‘Costs per kilowatt-hour sold,’ and are obtained by dividing the expenses and other items shown in the column ‘Amount’ by the number of kilowatt-hours sold during the year. The calculations should be carried out to the fourth place beyond the decimal point, as 0.1234.”

The following annual items are thus calculated upon a unit basis and are, therefore, available to the commission for comparison with other corporations: depreciation, salaries, wages, legal, taxes, rentals, materials used on repairs, fuel (current purchased), miscellaneous, total operating revenues and expenses, net operating revenues, nonoperating revenues, gross income or deficit, interest, other deductions, net income or deficit, dividends and surplus or deficit for current year.

This annual report³ consisting of thirty-seven pages of the above listed accounts and statistics must be filed annually after

having been sworn by the officers of the public service corporation before a notary public. It is the result of a detailed accounting system, outlined by the commission in another pamphlet of 118 pages,¹ which sets forth the required methods of arriving at such important unit data.

Specified References

1. "Uniform Classification of Accounts for Electric Utilities," Public Service Commission of Indiana, Indianapolis, 1924.
2. Acts of Indiana Legislature, 1917, p. 555.
3. "Annual Report of the _____ Electric Utility, Class A, to the Public Service Commission of Indiana."

Review Problems

1. In what respect do the accounts of a public utility differ from general commercial accounts?
2. What object is sought by the commission in requiring the detailed information outlined in this chapter?
3. What sort of information is included in the annual report of utilities to the commission?
4. What important advantage is gained by having all reports uniform?
5. How does the commission keep a check on the adequacy of the depreciation reserve of the utilities under its jurisdiction?

CHAPTER XXVII

DISTRIBUTION FACTORS

In virtually all lines of production there are four economic ideas that have been thoroughly established in the minds of producing engineers. These four principles are:

1. The larger the machine, the less the cost per unit of capacity; e.g., a $\frac{1}{2}$ -hp. motor costs about \$25 per horsepower while a 200-hp. motor costs only \$7 per horsepower.
2. The greater the quantity of production, the less the cost of production per unit of product. As an illustration consider the effect of fixed charges. In previous chapters we have seen that all enterprises are attended with certain costs termed fixed charges, which, for a given set of machines, are practically independent of the output of those machines. If these charges must be distributed over a relatively few units of output, the cost per unit must be high, whereas, if they are distributed over a large quantity, the share of each unit will be considerably less. There are even some operating costs which will be less for a large quantity production than for a small output.
3. Machines operating on or near their full rated load are more efficient than at some fractional part of their rating, and larger machines are generally more efficient than smaller ones.
4. Generally speaking, the most efficient equipment, i.e., that with the least operating losses and therefore the lowest operating costs, has the highest initial cost.

Distribution engineers, who devote a large proportion of their time to the solution of the problem of the most economical means of distributing electrical energy, must and do make use of the above basic ideas in all phases of the system from the generating station to the consumer.

For convenience, they express these principles in the form of ratios to enable them the better to apply the principles to specific conditions of customer usage. These ratios, their definitions and applications follow:

1. Load Factor.—The load factor is defined as the ratio of the average load to the maximum demand. The maximum demand, in turn, may be variously defined. It may be the instantaneous maximum load occurring in the period of time in question. In practice, because of the difficulty of obtaining this instantaneous value, the maximum demand is the maximum load drawn during any one of a number of definite intervals of time in a given period. The intervals commonly used are 15, 30, and 60 min. and the periods the day, the week, and the month or the year.

It follows that, in the case of a badly fluctuating load, the instantaneous maximum demand will usually be higher than the 15-min. interval maximum demand. In one case the following differences were noted on the load over the same period:

	Kw.
Instantaneous demand	1,000
15-min. interval	700
30-min. interval	600
60-min. interval	500

The load factor is customarily expressed as a percentage and involves any unit of power such as the kilowatt or the horsepower, both numerator and denominator of the ratio necessarily being expressed in the same units. It may also be determined as the ratio of the kilowatt-hours generated or delivered in a given period to the maximum demand in kilowatts multiplied by the number of hours in the period. Moreover, it may apply to the system as a whole or to any part of it.

Because of these variations in definition and application, the statement of a load factor should designate the interval, the period, and the part of the system involved, e.g., *the 15-min. weekly load factor of substation A is 30 per cent.*

The value of load factors met in practice vary between wide limits according to the types of customers, the periods, and the seasons of the year. It is obvious that for the most economic operation a load factor of 100 per cent is indicated. Seldom is this possible in practice, but much effort is expended by power companies to improve their load factors. Various forms of load building programs are often intended to redistribute as well as increase the gross load on the system.

Table LIV shows typical load-factor values and their variations with the period, the season, and the type of load they represent.

In Table LVII are tabulated the load factors of various businesses, as experienced in Chicago.

TABLE LIV.—TYPICAL 15-MIN. LOAD FACTORS OF A CENTRAL STATION¹
(Per Cent Load Factor)

	Lighting load			Interurban St. Ry.			City St. Ry.		
	Win- ter	Sum- mer	Aver- age	Win- ter	Sum- mer	Aver- age	Win- ter	Sum- mer	Aver- age
Daily . . .	35	32	33	62	59	60	52	52	52
Weekly . . .	30	27	28	60	57	58	50	50	50
Annual . . .	..	..	23	..	..	47	..	..	35
Industrial Load Lighting				Industrial Lighting			Industrial & St. Ry.		
	Win- ter	Sum- mer	Aver- age	Win- ter	Sum- mer	Aver- age	Win- ter	Sum- mer	Aver- age
Daily . . .	56	56	56	49	71	64	58	72	67
Weekly . . .	48	48	48	45	65	59	58	65	61
Annual . . .	..	..	46	..	..	40	..	..	45

2. Diversity Factor.—The diversity factor is the ratio of the sum of the maximum demands of the components of a system or part of a system to the maximum demand of the whole system or of the part of the system considered, measured at the point of supply.

It is evident that to have a diversity there must be at least two different loads associated with a single source of supply. Obviously one source and one load can have no diversity between their maximum demands. Thus customer *A* with a maximum 15-min. demand of 1,000 kw. and customer *B* with a maximum 15-min. demand of 600 kw. might, if both were supplied from a common source, produce a 15-min. maximum demand on that source of only 800 kw. In this example the diversity factor would be equal to $1,600/800 = 2$.

The significance of the factor 2 is that the maximum demands of *A* and *B* do not occur simultaneously. It means that the source, whether transformer bank, substation, or power station, will be required to stand a peak load of only one-half the sum of the peak loads supplied by it.

In general, any two or more customers supplied from a common transformer bank will produce a diversity at that bank, any two or more such banks will produce a diversity at the substation

TABLE LV.—Summation of Loads Shown in Fig. 41

Group	Kilowatts on peak	Maximum demand	Kilowatt-hours per day	Load factor
Railroads.....	280,000	280,000	2,720,000	0.405
Manufacturing.....	100,000	195,000	2,080,000	0.445
Retail commercial.....	160,000	185,000	2,080,000	0.468
Hotels, etc.....	160,000	160,000	1,760,000	0.458
Residential.....	165,000	230,000	1,760,000	0.319
Total.....	865,000	1,050,000	10,400,000	0.500

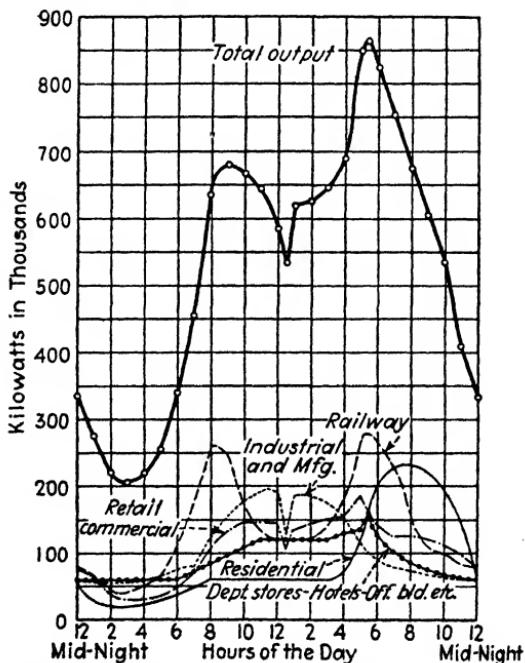


FIG. 41.—Central Station load curves. Maximum winter day, 1932-1933.

which supplies them, and finally any two or more such substations will produce a diversity at the generating station that supplies them.

The diversity factor may also be used to indicate the spread in maximum demands of classes or groups of customers with respect to the source. As an example of this latter application, consider the graphs on Fig. 41. It will be noticed that in only one case, i.e., railway and department stores, hotels, and office buildings, do the maximum demands occur at the same time. Thus the station diversity factor for the winter day in question was $1,050,000/865,000 = 1.214$. The daily load factors for the various groups and the station are also given. In this connection note that the average load for this day is only one-half the maximum load (see Table LV).

TABLE LVI.—TYPICAL DIVERSITY FACTORS²

	Residence light	Commercial light	General power	Large power
Between consumers.....	3.35	1.46	1.44	
Between transformers.....	1.3	1.3	1.35	1.15
Between feeders.....	1.15	1.15	1.15	1.15
Between substations.....	1.1	1.1	1.1	1.1
Consumer to transformer ..	3.35	1.46	1.44	
Consumer to feeder.....	4.36	1.90	1.95	1.15
Consumer to substation ..	5.02	2.19	2.24	1.32
Consumer to generator....	5.52	2.41	2.46	1.45

The diversity factor as well as the load factor varies with the seasons of the year. Trend values of diversity factors are shown in Table LVI. This table also illustrates how the diversity factor increases as we progress from the ultimate consumer toward the source of supply, but, on the other hand, the diversity between units on the same level decreases as we go from the consumer toward the generator.

3. Demand Factor.—The demand factor is the ratio of the maximum power demand of any system, or part of a system, to the total connected load of the system or of the part of the system under consideration. By connected load is meant the combined rating of all the receiving equipment on the consumer's premises that is connected to the system, whether actually used or not. The demand factor is customarily expressed as a percentage and, although ordinarily less than 100 per cent, might be greater than 100 per cent if equipment is overloaded.

It is obvious that this factor will vary over a very wide range for even a given class of consumers, and with the period and the seasons. An attempt to give typical values must therefore be based on the average of relatively large numbers. Such values are given in Table LVII.

TABLE LVII.—LOAD AND DEMAND FACTORS OF SMALL AND MEDIUM LIGHTING CUSTOMERS IN CHICAGO³

	Load factor, per cent	Demand factor, per cent
Banks.....	16.1	66.8
Churches.....	12.4	56.0
Flats.....	6.9	54.1
Hotels.....	24.4	28.0
Houses.....	7.8	43.0
Offices (business).....	9.2	64.2
Offices (professional).....	6.7	64.0
Restaurants.....	23.4	52.3
Shops (barber).....	11.5	70.4
Shops (machine).....	8.7	37.2
Shops (tailor).....	8.4	59.3
Stores (book).....	11.7	66.4
Stores (cigar).....	16.8	64.7
Stores (dry goods).....	8.2	76.5
Stores (drug).....	19.3	78.8
Stores (grocery).....	10.3	73.0
Theaters.....	17.2	49.0

The significance of the demand factor may be illustrated by a considerably overmotorized factory. In this case the demand factor would be low. In such a factory not all the motors would be in use and those that are used are only partly loaded. This results in a low demand which, when coupled with a high total of installed connected load, causes a low demand factor. On the other hand, a factory that is properly motorized would have a demand more nearly equal to the installed capacity, and thereby a much higher demand factor.

In other words, high demand factors indicate better and more efficient use of equipment than do low demand factors. This factor is used by distribution engineers to determine the feeder and transformer capacities necessary to furnish a class of cus-

tomers. For example, consider that three drugstores are to be supplied from a single transformer bank. Store A has a connected load of 50 kw., Store B one of 47 kw., and Store C one of 30 kw. From Table LVII the demand factor for drugstores is 78.8 per cent. Therefore a bank of transformers of

$$(50 + 47 + 30)0.788 = 100 \text{ kw.}$$

should suffice to carry these three stores. Of course, possible future increase in load might warrant an initial installation of a larger transformer bank or other factors might modify the above calculations.

4. Capacity Factor or Plant Factor.—The capacity factor is the ratio of the average load to the total rated capacity of the equipment supplying that load. Because of the variations in the method of rating apparatus, this factor is not very definite and therefore not so frequently used as the others. It has some application in power-cost studies. For instance, fixed charges are figured on the total installed capacity of a generating station; if all this capacity were to be used every hour of the year, each kilowatt-hour would carry only 1/8,760 part (8,760 hr. per year) of the total fixed charges on the kilowatt capacity installed, but, if the capacity factor were 50 per cent, this cost would be doubled. It is a factor indicating utilization of generating equipment.

Although the capacity factor thus defined is more frequently applied to the generation of electrical energy, one often hears the expression that a factory is running at 25 per cent or 75 per cent of capacity at any particular time.

5. Power Factor.—Power factor is best defined as the ratio of the kilowatts per phase to the kilovolt-amperes per phase. This factor enters the economic picture because low values of power factor are the cause of many increased costs in the generation and distribution of electrical energy. The three principal reasons for these increased costs are:

1. Increased kilovolt-ampere capacity of all current-carrying apparatus for a given power output expressed in kilovolts. Such apparatus includes generating equipment, transformers, switch gear, transmission and distribution lines, and other associated apparatus.

2. Increased losses in such equipment.

3. Poor voltage regulation over the entire system.

To illustrate the disadvantages of a low power factor, it is only necessary to recall that the voltage drop is proportional to the current and the loss is proportional to the square of the current. For a given kilowatt load, expressed in kilowatts, the current is 43 per cent larger at 70 per cent power factor than at unity power factor. Therefore the voltage drop is 43 per cent greater. The kilowatt loss however is slightly more than twice the unity-power-factor loss. Conversely, it means that, if a part of the system is operating at full capacity at 70 per cent power factor, the kilowatt output can be increased by 43 per cent if the power factor could be raised to unity. It follows then that under certain conditions it may be economical to install power-factor correcting apparatus for improving the power factor of the load as a whole or for a part of the load. Thus power-factor correcting equipment is frequently found in substations which terminate transmission lines and in large industrial establishments where a power-factor clause in the rate schedule is such as to allow a sufficient saving to make such installations economical.

The methods at present available for correcting a low power-factor condition are four in number, as follows:

1. Proper motorization of industrial establishments so that induction motors are properly loaded to give the highest possible power factor for the operating conditions of the application involved. In this connection, relocating machines or reorganizing production methods will often result in a better individual load condition for the induction motors that must be used and the elimination of others.

2. The use of synchronous and unity-power-factor motors, either in addition to present equipment or, where possible, in place of such equipment.

3. The use of capacitors (static condensers).

4. The use of synchronous condensers (overexcited synchronous motors running without mechanical load).

Which type of corrective apparatus to install in a given case depends not only upon the technical and economical aspects of the local situation but also upon the inherent advantages and disadvantages of the methods listed above.

Although induction motors inherently draw lagging currents, they may nevertheless be used to improve an existing power

factor if properly installed and operated as near full load as possible. They are exceedingly rugged in construction with consequent low maintenance cost and they possess suitable characteristics for most applications. These facts, coupled with their exceptionally low cost, make them the first choice when and where they will suffice. Synchronous motors and unity-power-factor motors are generally more expensive, less rugged in construction, and require greater maintenance cost. The need of direct current for the field of synchronous motors in some cases is often a disadvantage. Although their characteristics are not quite so universally applicable, they are becoming more generally used. They have greater corrective power than do induction motors and greater ease of control through the field rheostats. They can carry mechanical load as well as correct power factor, and at reduced load added corrective powers are available instead of less as in the induction motor. Capacitors, or static condensers, require no attention whatever. They are very efficient (losses less than 0.5 per cent). They may be applied directly at the source of low power factor with extreme flexibility as to size and location. They have the disadvantage of higher first cost, due to lack of capacitor diversity factor, which results in higher total capacity for the application. Also there is often objection to having additional apparatus in the immediate vicinity of the motor or the machine that it drives.

Synchronous condensers are likely to be advantageous where the corrective condensive kilovolt-amperes can be applied at one point and in amounts exceeding 300 kva. In this case they possess low first cost, inherent characteristics that tend to stabilize the voltage, and easy adjustment of the leading reactive kilovolt-amperes supplied. As compared to static condensers, they have greater losses and higher attendance and maintenance costs.

The place where power-factor corrective apparatus is installed depends upon local conditions and the economical gain to be obtained. A fundamental principle of such application is that power-factor corrective apparatus always improves the conditions of the system toward the source of power—never forward from the corrective apparatus toward the consumption of the power. Thus power-factor correction equipment located directly at a source of the low power factor (such as an electric furnace)

will improve, to some extent, the power factor of the main-line equipment from this point back to the generators at the power house. However, the power factor of the electric furnace itself is not affected. If such equipment is installed at the customer's transformer bank, it will improve the power factor of the distribution and transmission equipment toward the generating plant and the generators themselves, but will not improve the power factor of the customer's local distribution system. This does not mean that the customer will not be benefited, as improved voltage regulation will nevertheless result. In like manner, such equipment installed at a substation will improve the power factor of the transmission system only toward the source of supply but will not improve the power factor on the load side of the substation. Here again, however, improved voltage regulation will result on the load side.

In the solution of engineering and economic selection problems involving power-factor correction, circle diagrams are used consisting of combinations of power triangles. In this connection it is convenient to draw a power triangle representing an inductive or lagging power-factor load upward from the horizontal axis and a power triangle representing a leading power-factor load downward. This is done primarily because we are accustomed to having lagging quantities drawn behind in a counterclockwise rotation diagram. Thus in a circuit where the current is lagging behind the voltage, we draw the kilowatts of that circuit lagging behind the kilovolt-amperes of the circuit just as we would draw the current lagging behind the voltage.

To illustrate such a diagram, assume that a certain consumer has an average load of 800 kw. at 60 per cent lagging power factor and that it becomes necessary to install an additional 500-hp. motor to provide rated additional mechanical power. The operating conditions are such that this customer has the choice of the following three possibilities:

1. A 500-hp. induction motor having an efficiency of 92 per cent and a power factor of 80 per cent lagging.
2. Installation of the same motor with a static condenser to raise the combined power factor of motor and condenser to 95 per cent lagging.
3. A 500-hp. synchronous motor having a full-load efficiency of 90 per cent, which operates at unity power factor.

Since, for the time being, we are considering only the technical phases of power-factor corrections, we shall compare the three possibilities listed above as to the amount of power-factor correction possible for the customer at his transformer bank, and leave the economical aspects of the problem for subsequent consideration.

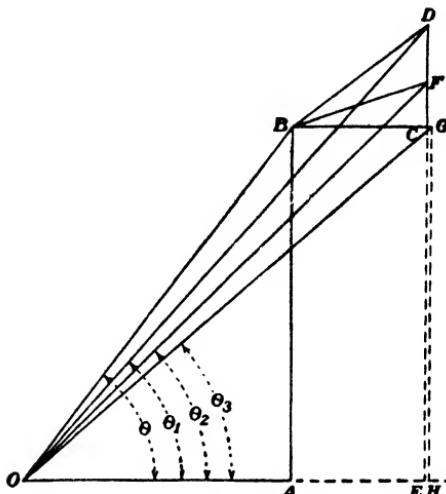


FIG. 42.—Power-factor correction with induction and unity-power-factor motors.

The first step is to determine the power triangle of the original load. The kilovolt-amperes of the original load are:

$$\frac{\text{kW.}}{\text{p.f.}} = \frac{800}{0.6} = 1,333$$

The power factor is

$$\cos \theta = 0.6 \quad \theta = 53^\circ$$

and

$$\sin \theta = 0.8$$

The lagging reactive kilovolt-amperes are

$$\text{kva.} \times \sin \theta = 1,333 \times 0.8 = 1,067$$

With a convenient scale and these figures, we construct triangle *OAB* of Fig. 42. This is the power triangle of the original load. For the reasons just discussed, this triangle is drawn upward but nevertheless represents a lagging power-factor load. The second step is to determine the power triangle of each of the

three motor possibilities and add each separately to the original load power triangle OAB . For case 1 the kilowatt input to the induction motor is

$$\frac{\text{hp.} \times 746}{\text{eff.} \times 1,000} = \frac{500 \times 746}{0.92 \times 1,000} = 405$$

The kilovolt-amperes are

$$\frac{\text{k.w.}}{\text{p.f.}} = \frac{405}{0.8} = 506$$

Since the sine of the angle whose cosine is 0.8 is 0.6, the reactive kilovolt-amperes are

$$506 \times 0.6 = 304$$

These figures, to the same scale, produce triangle BCD . Since the induction motor load is in addition to the original load, the induction-motor power triangle is added on to the original triangle at its apex B . It follows that the new combined kilowatt load is

$$OE = OA + BC = 800 + 405 = 1,205$$

The combined reactive kilovolt-amperes are

$$ED = AB + CD = 1,067 + 304 = 1,371$$

The combined kilovolt-amperes are

$$OD = \sqrt{(\text{k.w.})^2 + (\text{r.kva.})^2} = \sqrt{1,205^2 + 1,371^2} = 1,827$$

The resultant power factor of the combination is

$$\cos \theta = \frac{OE}{OD} = \frac{\text{k.w.}}{\text{kva.}} = \frac{1,205}{1,827} = 0.65$$

This is an improvement of 5 per cent over the original power factor.

For case 2 the kilowatt input to the motor will be the same as for case 1 since the motor is doing the same work. However, the kilovolt-amperes are

$$\frac{\text{k.w.}}{\text{p.f.}} = \frac{405}{0.95} = 426$$

and the reactive kilovolt-amperes are the kilovolt-amperes times the sine of the angle whose cosine is 0.95 = $426 \times 0.31 = 132$.

With these figures and the same scale, triangle BCF is drawn. In this case the combined kilowatt load is still

$$OF = OA + AE = 800 + 405 = 1,205$$

but the combined reactive kilovolt-amperes are equal to

$$EF = AB + CF = 1,067 + 132 = 1,199$$

The combined kilovolt-amperes are

$$OF = \sqrt{OE^2 + EF^2} = \sqrt{1,205^2 + 1,199^2} = 1,700$$

The resultant power factor is

$$\cos \theta_2 = \frac{OE}{OF} = \frac{1,205}{1,700} = 0.71$$

This is an improvement of 6 per cent over the previous case and of 11 per cent over the original load.

In case 3 the kilowatt input to the synchronous motor is

$$\frac{\text{hp.} \times 746}{\text{eff.} \times 1,000} = \frac{500 \times 746}{0.9 \times 1,000} = 414$$

Since the kilovolt-amperes taken by the motor are equal to the kilowatts divided by the power factor, it follows that, when the motor power factor is unity, the kilovolt-amperes are equal to the kilowatts and the reactive kilovolt-amperes of the motor are equal to zero. Thus the power triangle of the synchronous motor reduces to a straight line BG , 414 units long. The combined kilowatts are now

$$OH = OA + BG = 800 + 414 = 1,214$$

The combined reactive kilovolt-amperes are

$$HG = AB = 1,067$$

and the combined kilovolt-amperes are

$$OG = \sqrt{OH^2 + HG^2} = \sqrt{1,214^2 + 1,067^2} = 1,616$$

The resultant power factor is

$$\cos \theta_3 = \frac{OH}{OG} = \frac{1,214}{1,616} = 0.75$$

This is an improvement of 15 per cent over the original load.

Thus, as far as power-factor improvement is concerned, the synchronous motor is preferable.

In case 3 the synchronous motor was operated at unity power factor primarily for the purpose of producing mechanical output. If the mechanical load is reduced on a synchronous motor and the field excitation is increased in the right ratio, the machine may be made to draw a leading current of the same magnitude. The more the load is reduced and the field increased, the more

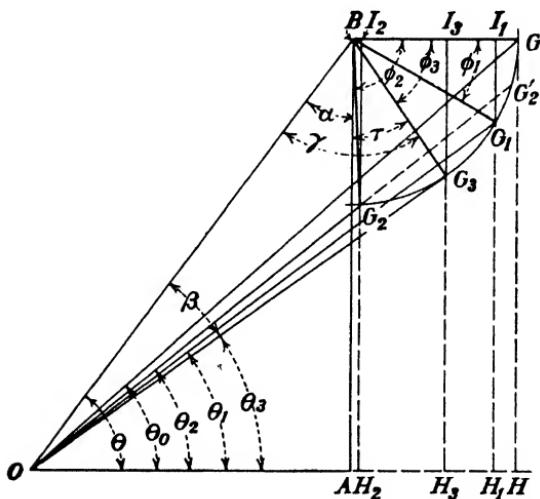


FIG. 43.—Power-factor correction with a synchronous motor.

leading the current will be. If the load is reduced to zero and the field is increased until the machine is drawing rated current, it will be found to be leading by nearly 90 deg. When operating in this condition, the machine is called a synchronous condenser. For a technical explanation of this phenomenon it is suggested that the reader consult any standard textbook on alternating-current machinery, as space will not permit of its consideration here.

As far as power-factor correction is concerned, such operation of a synchronous motor produces the results illustrated in Fig. 43. In this figure, triangle OAB represents the same original load of the previous figure and BG is the synchronous-motor input at rated load and unity power factor. Hence, BG is also the rated kilovolt-amperes of the machine; an arc with B as a center and

BG as a radius will give the locus or end position of the rated kilovolt-ampere line at whatever power factor the motor happens to be operating. Consider the motor operating at rated kilovolt-amperes but 0.87 power factor leading. The angle of lead ϕ_1 of the motor kilovolt-ampere line BG_1 is then equal to the angle whose cosine is 0.87, or 30 deg. When it is operating at this point, the leading reactive kilovolt-amperes are equal to $G_1 I_1$ and the kilowatts drawn by the motor are equal to $BI_1 = AH_1$. It should be noticed that AH_1 is less than AH . In order not to overload the motor, some of the mechanical output must be sacrificed when it furnishes the leading reactive kilovolt-amperes corresponding to $G_1 I_1$. Now consider the motor operating at maximum leading power-factor angle ϕ_2 . The only reason that ϕ_2 cannot be 90 deg., so that therefore BG_2 will be located vertically downward from B , is that the motor must take some power to overcome its no-load losses. In Fig. 43 the no-load losses were assumed at 5 per cent or $0.05 \times 414 = 21$ kw. This power is required to operate the motor at no load. Therefore $BI_2 = AH_2 = 21$. For this condition of operation the power input to the motor is reduced from AH to AH_2 but the leading reactive kilovolt amperes have increased from zero at unity power factor to $G_2 I_2$ at this point of maximum leading power factor of the motor. It should be noted that, although the motor is operating at full electrical load, its mechanical output is zero.

The two points G_1 and G_2 will suffice to illustrate the fact that, by proper adjustment of the field and mechanical output of the motor, it may be caused to operate anywhere along the arc GG_2 between the points G and G_2 and that, when thus operating, the kilowatt input to the motor is the projection of the arc end of the motor kilovolt-ampere line upon the horizontal; and the leading reactive kilovolt-amperes are represented by the projection of this point upon the vertical.

To determine the effect upon the power factor of the combined loads, when operating the motor at various leading power factors, draw lines from O to G , G_1 , G_2 , etc. These lines represent resultant kilovolt-amperes of the combined loads and the angles θ_0 , θ_1 , θ_2 , etc., represent the power-factor angles of the combination whose cosines are the power factors of each operating condition, respectively.

To determine $\cos \theta_1$, proceed as follows:

$$\cos \phi_1 = 0.87$$

Therefore

$$AH_1 \text{ or } BI_1 = BG_1 \cos \phi_1 = 414 \times 0.87 = 360$$

The combined kilowatts are

$$OA + AH_1 = 800 + 360 = 1,160$$

The reactive kilovolt-amperes of the motor are

$$G_1 I_1 = BG_1 \sin \phi_1 = 414 \times 0.5 = 207$$

The combined reactive kilovolt-amperes are

$$H_1 G_1 = H_1 I_1 - G_1 I_1 = AB - G_1 I_1 = 1,067 - 207 = 860$$

The combined kilovolt-amperes are

$$\sqrt{\text{kW.}^2 + \text{r.kva.}^2} = \sqrt{1,160^2 + 860^2} = 1,446$$

The power factor is

$$\cos \theta_1 = \frac{\text{kW.}}{\text{kva.}} = \frac{1,163}{1,446} = 0.8$$

$\cos \theta_2$ is found in a similar manner. The combined kilowatts are

$$OA + AH_2 = 800 + 21 = 821$$

$$G_2 I_2 = \sqrt{BG_2^2 - BI_2^2} = \sqrt{414^2 - 21^2} = 413$$

The combined reactive kilovolt-amperes are

$$AB - G_2 I_2 = 1,067 - 413 = 654$$

The combined kilovolt-amperes are

$$\sqrt{821^2 + 654^2} = 1,049$$

$$\cos \theta = \frac{821}{1,049} = 0.78$$

$\cos \theta_2$ is less than $\cos \theta_1$, and therefore the power-factor improvement was greater when the motor was operated at G_1 . At first thought this appears to be contrary to what was expected, but, if the line OG_2 is extended until it cuts the arc again at G_2' , it will be noticed that, as far as the resultant power factor of the

combination is concerned, it makes no difference whether the motor is operated at G_2 or G'_2 .

The above discussion raises the question as to the point of operation of the motor for maximum resultant power-factor improvement. In general, this point is where the resultant kilovolt-ampere line is tangent to the arc representing the locus of the motor kilovolt-amperes. In Fig. 43 this point is G_3 . This point may be determined by remembering that the radius BG_3 makes a 90-deg. angle with the line OG_3 at the point of tangency. From the geometry of the figure $\theta_3 = \theta - \beta$ and $\theta_3 = \tau$

$$\begin{aligned}\gamma &= 90 - \beta \quad \text{and} \quad \tau = \gamma - \alpha \\ \sin \beta &= \frac{BG_3}{OB} = \frac{414}{1,333} = 0.311 \\ &= 18^{\circ}7'\end{aligned}$$

Therefore

$$\theta_3 = 53^{\circ}7' - 18^{\circ}7' = 35^{\circ}$$

or

$$\begin{aligned}\gamma &= 90 - 18^{\circ}7' = 71^{\circ}53' \\ \tau &= 71^{\circ}53' - 36^{\circ}53' = 35^{\circ} = \theta_3 \\ \cos \theta_3 &= 0.82\end{aligned}$$

A power factor of 82 per cent is the maximum that can be obtained with a motor of the capacity specified and an original load of the size and power factor given. It is a 22 per cent improvement. When operating at point G_3 , the motor has a leading power factor of $\cos \phi_3 = \cos (90^{\circ} - 35^{\circ}) = 0.57$ and the kilowatt input to the motor is $414 \times 0.57 = 236$. The horsepower delivered by the motor is $236 \times 0.9/0.746 = 285$.

A study of these figures shows that it is impossible to have maximum power-factor correction and maximum horsepower output of the correcting motor simultaneously. Either one may be obtained alone but not both together.

It sometimes happens that a customer wishes to provide some additional mechanical power and at the same time raise the combined power factor to a specific value. In this case the technical question is, what size motor will have to be used? Using the same base load as above and assuming that 500 hp. additional mechanical load is desired with the combined power

factor corrected to 80 per cent, how large a synchronous motor will it take to accomplish this result? If the motor is 90 per cent efficient, the kilowatt input will be

$$\frac{500 \times 0.746}{0.9} = 414 \text{ kw.}$$

The combined kilowatts of original load and new motor will then be

$$800 + 414 = 1,214$$

If the power factor of this combined load is to be 80 per cent, the kilovolt-amperes of the combined load are:

$$\frac{\text{kw.}}{\text{p.f.}} = \frac{1,214}{0.8} = 1,518$$

The reactive kilovolt-amperes of the combined load are then the kilovolt-amperes multiplied by the sine of the angle whose cosine is 0.8 or

$$1518 \times 0.6 = 911$$

The reactive kilovolt-amperes of the original load was 1,067. If this is to be reduced to 911, the synchronous motor must furnish

$$1,067 - 911 = 156 \text{ r.kva.}$$

The kilovolt-amperes of the synchronous motor are then equal to

$$\sqrt{414^2 + 156^2} = 442.$$

In practice the nearest standard rating to 442 would customarily be used rather than attempt to purchase an odd size of motor.

One other variation of the technical phases of the power-factor correction problem is of interest. Suppose that the capacity of the transformer bank supplying the original load under discussion above is equal to the kilovolt-amperes of that load and that it is desired to add a synchronous motor to give all the mechanical load possible and at the same time correct the power factor to as great an extent as possible without having either accomplishment exceed the kilovolt-ampere capacity of the present transformer bank. Using the same scale as before, Fig. 44 indicates the method of solution for the new power factor and motor out-

put. Triangle OBA represents the original load. The point of operation of the motor G_4 is determined by the interconnection of two arcs. One arc is drawn with B as a center and BG (synchronous-motor kilovolt-ampere rating) as radius, and the second arc is drawn with O as a center and OB as a radius (transformer kilovolt-ampere rating). Since triangle OBG_4 is isosceles and not a right triangle, its solution is best accomplished by bisecting the angle ψ with the line OJ , making thereby two right

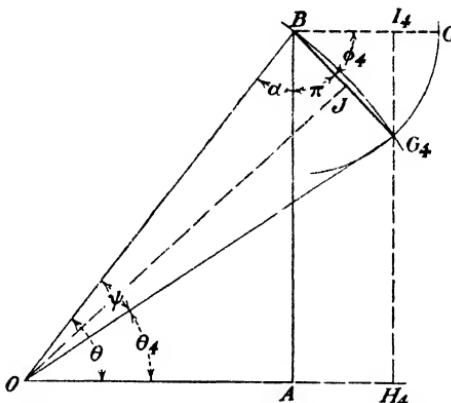


FIG. 44.—Power-factor correction not to exceed the original kilovolt-ampere capacity of the source.

triangles. Then $\sin \psi/2 = 1/2BG_4/OB = 207/1,333 = 0.155$, $\psi/2 = 8^{\circ}55'$, $\psi = 17^{\circ}50'$, and, since $\theta = 53^{\circ}$, θ_4 will be

$$53^{\circ}8' - 17^{\circ}50' = 35^{\circ}18'.$$

The combined power factor is therefore $\cos \theta_4 = \cos 35^{\circ}18' = 0.82$. The particular combinations of figures chosen and the policy of rounding out decimals to whole numbers causes the value above to coincide with the power factor obtained at maximum possible correction. The point G_4 of Fig. 44 is not, however, the same point G_3 of Fig. 43. The angle OG_3B of Fig. 43 is a right angle but the angle OG_4B of Fig. 44 is not a right angle. It is, of course, very close to a right angle; hence the apparent identity.

In order to determine the output of the motor, the angle ϕ_4 is first found as follows:

$$\alpha + \pi = 90^{\circ} - 8^{\circ}55' = 81^{\circ}5'$$

Since α is equal to $36^\circ 52'$, $\pi = 81^\circ 5' - 36^\circ 52' = 44^\circ 13'$. From the figure $\phi_4 = 90^\circ - \pi = 90^\circ - 44^\circ 13' = 45^\circ 47'$ and

$$\cos \phi_4 = 0.697 \text{ and } BI_4 = 414 \times 0.697 = 288 \text{ kw.}$$

If the efficiency of this motor at this load is 87 per cent, the horsepower output would be

$$\frac{288 \times 0.87}{0.746} = 336$$

There are, of course, numerous other combinations that might arise in a given problem, but the group included here shows a sufficiently varied range of applications of the power-factor correction circle diagram to enable the student to handle almost any problem that may confront him.

Besides the technical problem illustrated above, each power-factor correction problem involves certain economic phases which determine whether or not it will pay to correct power factor at all. The annual-cost method of comparison described in Chap. XXII is suitable for such studies and will be used here.

Ordinarily, the advantages of improved service and increased energy capacity of feeders and associated apparatus are of secondary importance to the customer who contemplates improving his power factor. The principal economic advantages to him are either the reduction in his present power bill or the installation of additional power without increasing his present power bill appreciably. Therefore, unless the rate schedule* under which he operates has a power-factor clause liberal enough to make it economically possible for him to accomplish one or the other of the above advantages, he will not install power-factor corrective apparatus. Thus the power-factor clause is of utmost importance, since from this source must come the gross revenue out of which to pay the annual cost of the corrective apparatus and any net gain that may result.

Although power-factor clauses in rate schedules differ widely, the following is typical: An average power factor is determined, say 80 per cent, and, if the customer raises his power factor above this value at the time of his maximum demand, his demand for billing purposes is reduced by the ratio of the average power

* See Chap. XXVIII.

factor to the actual power factor. On the other hand, if he falls below the average at the time of his maximum demand, his actual demand for billing purposes is increased by the ratio of the average to the actual power factor. Thus, suppose a customer has an actual demand of 2,000 kw. and his power factor at the time of this demand was 90 per cent. His billing demand would be $2,000 \times 80\% = 1,780$ kw. Or if his actual power factor happened to be 70 per cent at the time of this demand, his billing demand would be $2,000 \times 80\% = 2,285$ kw. The average power factor is usually determined over a relatively long period, say approximately a year.

Power-factor Correction with Additional Mechanical-power Requirement.—The following example will illustrate the analysis to be made to determine the correct choice of motor for a given load requirement where advantage can also be taken of power-factor correction.

The present average electrical power required by a consumer for a typical day of 8 hr. during 300 days per year is 800 kw. at 60 per cent power factor and maximum demand of 1,000 kw.

The rate schedule provides for a charge of \$1.40 per kilowatt per month of billing demand. The billing demand is to be figured by multiplying the actual demand by the ratio of the average power factor of 70 per cent to the actual power factor expressed in per cent. In addition, energy costs 2 cts. per kilowatt-hour per month.

It becomes necessary to install a 500-hp. motor to provide rated additional mechanical power during all the above operating time. It is estimated that the maximum demand will be increased by the kilowatt input to this motor and that the additional energy may be purchased at the same rate as the original load. Which of the following installations is preferable?

1. A 500-hp. induction motor having an efficiency of 92 per cent and a power factor of 80 per cent lagging, at a cost of \$10 per rated horsepower installed. Fixed charges at 10 per cent.
2. Installation of the same motor with a static condenser to raise its power factor to 95 per cent at a total combined cost of \$15 per horsepower of motor rating. Fixed charges at 12 per cent.
3. A 500-hp. synchronous motor to operate at full load. Such a motor has an average efficiency of 90 per cent, no load

losses of 5 per cent, and is estimated to cost \$12 per horsepower installed. Fixed charges at 15 per cent.

The first step in the solution of this problem is to determine the resulting power factor for each case above. Since these three motors are the same three that were used earlier in this chapter and for which Figs. 42 and 43 were drawn, we can consider all the calculations connected therewith as part of this problem and as having been done here. The second step is then to compare the annual cost of each case. On the assumption that either motor is equally satisfactory as far as local load requirements go, it may be assumed that the one with the lowest annual cost is preferable. It is convenient to arrange the calculations in tabular form as in Table LVIII. Item 1 is the first cost of each case figured from the cost per horsepower, as shown. Item 2 is the total fixed charges. Item 3 is the new power factor resulting from the combination of the new motor and original load as figured previously. Item 4, the new demand, is obtained by adding to the original demand the demand of the new motor. The billing demand (item 5) is obtained by multiplying the actual demand by the ratio of the average to the new power factor.

The demand charge (item 6) is obtained by multiplying the billing demand by the rate per kilowatt per month and then multiplying by the number of months in a year. Item 6 is the first item of the operating expense. Items 7 to 10 inclusive comprise the calculation of the energy charge, or second item in the operating expense. In this group of calculations, the average kilowatts are found by adding to the average of the original load the average kilowatt consumption of the new machine. Item 11 is then the annual cost, consisting of the fixed charge (item 2) and the operating expense (items 6 and 10). Item 12 is, of course, the difference between the annual cost of the induction motor and the induction motor plus condenser. Item 13 is a similar calculation for the synchronous motor.

On the assumption that any of the three combinations will be satisfactory as far as the load requirements and local conditions are concerned, the synchronous motor shows a saving of \$666.72 per cent over its nearest competitor.

Power-factor Correction Using the Synchronous Condenser.—
If the customer just considered did not require any additional

TABLE LVIII.—ECONOMIC SELECTION OF BEST MOTOR COMBINATION WHEN ADDITIONAL POWER IS REQUIRED

Num-ber	Item	Calculations, induction motor	Calculations, induction motor plus condenser	Calculations, synchronous motor
1	First cost.....	\$500 × 10 = \$ 5,000.00	\$500 × 15 = \$ 7,500.00	\$500 × 12 = \$ 6,000.00
2	Fixed charges.....	\$5,000 × 0.10 = \$ 500.00	\$7,500 × 0.12 = \$ 900.00	\$6,000 × 0.15 = \$ 900.00
3	Corrected power factor.....	page 556 65 per cent	page 557 71 per cent	page 557 75 per cent
4	New demand.....	1,000 + 405 = 1,405	1,000 + 405 = 1,405	1,000 + 414 = 1,414
5	Billing demand.....	1,405 × 7% = 1,513	1,405 × 7½% = 1,385	1,414 × 7½% = 1,319.6
6	Demand charge.....	1,513 × \$1.4 × 12 = \$25,418.40	1,385 × \$1.4 × 12 = \$23,268.00	1,319.6 × \$1.4 × 12 = \$22,169.28
7	Average kilowatts.....	800 + 405 = 1,205	800 + 405 = 1,205	800 + 414 = 1,214
8	Hours per year.....	8 × 30 = 2,400	8 × 300 = 2,400	8 × 300 = 2,400
9	Kilowatt-hours.....	1,205 × 2,400 = 2,892,000	1,205 × 2,400 = 2,892,000	1,214 × 2,400 = 2,913,600
10	Energy charge.....	2,892,000 × \$0.02 = \$57,840.00	2,892,000 × \$0.02 = \$57,840.00	2,913,600 × \$0.02 = \$58,272.00
11	Total annual cost (item 2 plus 6 plus 10)	\$83,758.40	\$82,008.00	\$81,341.28
12	Induction motor + condenser over induction motor.....	.....	.....	\$ 1,750.40
13	Synchronous motor over induction motor + condenser.....	.....	.....	\$ 666.72

TABLE LIX.—ECONOMIC ADVANTAGE OF POWER-FACTOR CORRECTION WHEN ADDITIONAL POWER IS NOT REQUIRED. USE OF THE SYNCHRONOUS CONDENSER

Number	Item	Calculations, original load	Calculations, synchronous motor
1	First cost.....	.....	\$500 X 12 = \$ 6,000.00
2	Fixed charges.....	.....	\$6,000 X 0.15 = 900.00
3	Corrected power factor.....	.....	page 560 78
4	New demand.....	.....	1,000 + 21 = 1,021
5	Billing demand.....	1,000 1,000 X 7% = 1,167	1,021 X 7% = 916
6	Demand charge.....	1,167 X \$1.4 X 12 = \$19,605.60	916 X \$1.4 X 12 = \$15,388.80
7	Average kilowatts.....	800	800 + 21 = 821
8	Hours per year.....	8 X 300 = 2,400	8 X 300 = 2,400
9	Kilowatt-hours.....	800 X 2,400 = 1,920,000	821 X 2,400 = 1,970,400
10	Energy charge.....	1,920,000 X \$0.02 = \$38,400.00	821 X 2,400 = \$39,408.00
11	Total annual cost (item 2 plus 6 plus 10)	1,970,400 X \$0.02 = \$39,408.00	\$55,696.80
12	Advantage of power-factor correction.....	\$58,005.60	\$ 2,308.80
13	Yield or per cent on investment.....	.....	\$2,308.8 / \$6,000.0 X 100 = 38.46 per cent

mechanical power, would it pay him to install a 500 hp. synchronous condenser? A synchronous motor of this size operating as a synchronous condenser would produce a resulting power-factor angle equal to θ_2 of Fig. 43. The motor itself would operate at point G_2 on the arc of Fig. 43 and at a leading power factor equal to $\cos \phi_2$. In this case the resultant power-factor $\cos \theta_2$ was found to be 78 per cent. In Table LIX below, a calculation is made similar to that of Table LVIII. Here, however, the comparison is made between the annual cost of the original load and the annual cost of the original load plus the synchronous condenser. It is found that an annual saving of \$2,308.80 results from such an installation. This saving amounts to 38.46 per cent on the investment required.

It must not be assumed that a yield of this magnitude is always possible. These problems are primarily for the purpose of illustrating the principles of economic selection and hold only for the particular set of conditions therein assumed. Such a set of conditions might never exist in practice. However, whatever the actual conditions might be, they would enter into the problem exactly as they do in these examples, each different set of conditions producing a different result.

Specific References

1. "Standard Handbook for Electrical Engineers," 6th ed., Sec. 13-22, McGraw-Hill Book Company, Inc., New York.
2. *Ibid.*, 5th ed. Sec. 25-115.
3. *Ibid.*, 5th ed. Sec. 25-107.

Review Questions

1. Four groups of consumers, supplied from one power station, have maximum demands of: $A = 1,000$, $B = 1,700$, $C = 1,800$, and $D = 800$ kw. The maximum demand on the power station is 4,000 kw. The energy output of the station, neglecting line losses, per typical 24-hr. day is 30,000 kw-hr. The generating equipment comprises two 5,000 kva. turboalternators.
 - a. What is the diversity factor of these loads at the power station?
 - b. What is the station-load factor?
 - c. What is the station-capacity factor?
2. The daily load factor of a power station is $33\frac{1}{4}$ per cent, and its maximum demand is 3,000 kw. The investment for the entire system is \$300 per kilowatt of power-station rated capacity with a station capacity

factor of 20 per cent. The gross revenue per annum amounts to an average of \$0.06 per kilowatt-hour of output and the operating ratio, excluding fixed charges, is 60 per cent. Fixed charges (exclusive of interest) may be considered to be 8 per cent of the investment. Calculate the following values:

- a. Rated capacity of the power station in kilowatts.
- b. Capital investment in dollars.
- c. Annual energy output in kilowatt-hours.
- d. Gross revenue per annum.
- e. Operating expenses per annum.
- f. Fixed charges per annum.
- g. Net income per annum in dollars.
- h. How much larger net income would be possible if the load factor could be raised to 40 per cent if the maximum demand, operating ratio, and investment remained the same?

- 3.** Four consumers supplied from the same transformer have connected loads, maximum demands, and average daily loads as follows:

	Connected load, kw.	Maximum demand, kw.	Average load. kw.
<i>A</i>	30	20	10
<i>B</i>	15	8	2
<i>C</i>	10	3	1
<i>D</i>	5	1	0.4

- a. What is the demand factor of each?
- b. What is the load factor of each?
- c. If the maximum demand upon the transformer is 26 kw., what is the diversity factor at the transformer?
- d. If two transformers having the above loads and the maximum demands similar to that of (c) but of efficiencies of 96 and 97 per cent, respectively, are supplied by the same feeder in which the loss is 10 per cent of the transformer inputs, what is the diversity factor at the power station if the maximum wattmeter reading for this feeder is 50 kw.?
- e. What is the load factor of the feeder at the power station?

- 4.** Five customers residing in a new subdivision receive their electricity from one transformer. By actual count the five customers have a total connected load as follows:

	Watts
Customer <i>A</i>	500
Customer <i>B</i>	1,000
Customer <i>C</i>	1,500
Customer <i>D</i>	700
Customer <i>E</i>	300

Experience has shown that consumers of this type may each be assumed to have a demand factor of 0.6. If their diversity factor is 1.2 and the load factor at the transformer is 0.32, what is the maximum demand on the transformer and the kilowatt-hours of energy consumed by the group in a thirty-day month?

5. The daily load factor of a power station is 30 per cent, with a maximum demand of 1000 kw. If the load factor can be increased to 40 per cent, without increasing the maximum demand:

- a. How much more energy, expressed in kilowatt-hours, can be sold per annum?
- b. If the value of the power station is \$200 per kilowatt of maximum demand and energy sells for 2 cts. per kilowatt-hour, what additional percentage yield is possible per annum on the investment?

6. Three consumers *A*, *B*, and *C* with maximum demands of 90, 110, and 160 kw., respectively, are to be supplied with power from one transformer. Their load factors are 21, 30, and 35, respectively.

- a. If the diversity factor of the consumers' maximum demands is 1.2, what is the maximum demand upon the transformer?
- b. The load in (a) is made up of 200 kw. for 13 hr. and no load for the other 11 hr. of the day. Two types of transformers, *X* and *Y*, are available for this installation. Transformer *X* is quoted at \$6 per kilovolt-ampere, with an efficiency of 97 per cent when loaded at the above load; core loss is 1.5 per cent of the kilovolt-ampere rating. Transformer *Y* is quoted at \$6.50 per kilovolt-ampere with an efficiency of 98 per cent when loaded as above; core loss is 1 per cent of the kilovolt-ampere rating. Assuming the transformer rating to be exactly in accordance with the maximum demand upon the transformer, the fixed charges as 10 per cent, and the energy worth $1\frac{1}{2}$ cts. per kilowatt-hour, what are the total annual expenses exclusive of output for each type of transformer?

7. A certain factory has a maximum demand of 2,000 kw. at its transformer bank and the sum of ten departmental demand meters read 3,000 kw. The demand factor is 80 per cent, the load factor 60 per cent.

- a. Determine the diversity factor, the connected load, the average load, and the capacity factor.
- b. Is a transformer bank rating of 2,400 kw. correct for this factory? If not, what should it be?

8. Five consumers supplied from the same transformer have an average demand factor of 40 per cent. The sum of their connected loads is 30 kw. Their diversity factor is 1.5.

- a. What is the simultaneous demand in kilowatts upon the transformer?
- b. With a load factor of 30 per cent, what is the average load upon the transformer in kilowatts?

9. Three consumers *X*, *Y*, and *Z* are supplied from one transformer. Their loads and demands are as indicated in the table.

	X, kw.	Y, kw.	Z, kw.
Connected load.....	10	5	5
Maximum demand.....	5	5	2
Average load.....	2	3	2

- a. What is the load factor for X?
- b. What is the demand factor for Y?
- c. What is the maximum demand on the transformer if the diversity factor is 1.1?

Two groups of consumers similar to those above are supplied by means of two transformers connected to the same feeder. The efficiency of each transformer is 93 per cent. Line losses are 10 per cent of the transformer inputs. If the maximum demand on the feeder at the sending end is 23 kw., calculate:

- d. The diversity factor at the sending end.
- e. The load factor at the sending end.

10. In designing a new substation to serve three large industrial customers, it is found that these customers have the following energy requirements.

	Connected load, kw. ,	Maximum demand, kw.	Average load, kw.
A	25,000	20,000	4,000
B	12,000	6,000	6,000
C	5,000	1,500	600

If the diversity factor between the customers at the substation is 1.375 and the total rating of the transformers is to be equal to the maximum demand on the substation, determine the load and demand factors of the substation.

11. Three groups of consumers, supplied from one power station, have connected loads, maximum demands, and average loads as follows:

Group	Connected load, kw.	Maximum demand, kw.	Average load, kw.
A	2,500	2,000	400
B	4,300	3,000	1,000
C	9,000	3,600	2,000

The maximum demand on the station is 7,200 kw.

- a. What is the demand factor of each group?
- b. What is the load factor of each group?
- c. What is the diversity factor at the station bus?

- 12.** A distribution engineer is making a load study of Substation *A*. Graphic meters on the six feeders read as follows:

Feeder	Maximum demand, kw.	Average load, kw.
1	500	420
2	800	740
3	200	160
4	700	400
5	600	260
6	400	140

A graphic meter on the main bus gives the substation *MD* as 2,500 kw.

- a. What is the diversity factor at the substation?
- b. What is the load factor at the substation?
- c. If the substation capacity factor is 0.6, what is the installed capacity?
- d. What is the lowest feeder load factor?

- 13.** The table below shows the maximum demands, connected loads, and energy consumption of three customers supplied by one transformer 24 hr. a day, 365 days a year.

	<i>A</i>	<i>B</i>	<i>C</i>
Kilowatt-hours per year.....	8,000	8,000	8,000
Maximum demands.....	3	5	4
Connected loads.....	5	10	12

- a. What is the load factor of customer *A*?
 - b. What is the demand factor of customer *B*?
 - c. What is the correct size of transformer to supply all these loads if the diversity factor may be taken as 1.2?
 - d. What is the load factor of the transformer?
 - e. What is the demand factor of the transformer?
- 14.** Two customers *A* and *B* are the only customers fed from transformer *C*. *A* has a connected load of 80 kw., an average load of 20 kw., and a maximum demand of 50 kw. At transformer *C* the maximum demand is 70 kw., the diversity factor is 1.2, the daily load factor is 40 per cent, and the demand factor is 60 per cent. Determine the average, maximum, and connected loads of customer *B*.

- 15.** A certain factory consists of four departments *A*, *B*, *C*, and *D*, fed from a 1500-kw. transformer bank. By suitable meters the factors and quantities in the following table were determined for each department and the plant as a whole.

Department	Connected load, kw.	Load factor	Demand factor
A	100	0.90	1.20
B	500	0.70	0.80
C	300	0.50	0.50
D	600	0.85	0.70
Total plant	1,500	....	0.60

Determine the plant load factor, capacity factor, and diversity factor.

16. Three groups of consumers, supplied from one power station, have connected loads, maximum demands, and average loads as follows:

Group	Connected load, kw.	Maximum demand, kw.	Average load, kw.
A	5,000	4,000	800
B	8,560	6,000	1,800
C	18,000	7,200	4,320

The maximum demand on the station is 12,300 kw. and the installed capacity is 13,600 kw.

- a. What is the demand factor of each group?
- b. What is the load factor of each group?
- c. What is the diversity factor at the station?
- d. What is the load factor at the station?
- e. What is the capacity factor at the station?

17. The various departments of a factory have maximum demands for power of 15, 25, and 30 kw., respectively. If the diversity factor is 1.2,

- a. What transformer rating will supply the load?
- b. With a capacity factor of 40 per cent at the transformer, how much energy will be required per day?
- c. If the load factor of the third department listed is 15 per cent, how much energy will it require per day?

18. A consumer with an average power load of 1,000 kw. at 0.5 power factor lagging adds a synchronous motor of 500 kva. capacity.

- a. At what kilowatts should this motor be operated for maximum correction?
- b. What is the new combined power factor of the consumers' loads?

19. A certain consumer has an average load of 800 kw. at a power factor of 60 per cent lagging. He purchases and installs a 500-hp. synchronous motor having a full-load efficiency of 90 per cent. What is the system power factor when this machine is operating at maximum possible leading power factor? Assuming the same efficiency at the new operating condition.

20. A customer has an average load of 600 kw. at 0.6 power factor. What size synchronous condenser will he have to install to correct this power

factor to unity if the no-load losses of the machine amount to 8 per cent of its kilovolt-ampere rating?

21. A certain factory has an average load of 600 kw. at 0.6 power factor. A certain synchronous motor is capable of drawing 500 kva. from the line without overheating. What is the resultant system power factor for maximum correction possible?

22. A customer's present load averages 600 kw. at 0.6 power factor lagging. He adds a synchronous motor load which draws 107 kw. additional power and enough leading reactive kilovolt-amperes to make the resultant kilovolt-amperes of the original load plus the motor equal to those of the original load.

- a. Determine the resultant power factor of original load plus motor.
- b. Determine the power factor at which the motor must operate.

23. A manufacturing concern has an induction furnace which draws 400 kw. at 0.4 power factor lagging from a 1,000 kva. transformer bank. What would be the smallest kilovolt-ampere capacity of a static condenser which would enable a second *identical* furnace to be operated in parallel with the first from the *same* transformer bank without exceeding the kilovolt-ampere capacity of that bank? Losses in the condensers may be neglected.

24. A customer having an average power load of 500 kw. and a load factor of 40 per cent with an average power factor of 75 per cent adds a synchronous motor and operates it at 400 kw. input, 100 per cent power factor.

- a. What is the new combined power factor of the consumer's loads?
- b. How much more power may be supplied at the new power factor by the original system without exceeding the kilovolt-ampere rating of the original equipment?

25. A factory owner with an average load of 600 kw. at 60 per cent power factor lagging wishes to add 100 hp. of additional motor capacity and to increase his power factor to 70.7 per cent including the new motor. The motor efficiency is 90 per cent.

- a. What is the kilovolt-ampere input rating of the motor?
- b. At what leading power factor should the motor be operated?
- c. What is the combined kilovolt-ampere load on the transformer bank?

26. A stone mill with an average load of 900 kw. at 0.6 power factor lagging purchases a 400-kva. synchronous motor direct connected to an air compressor. This motor is operated to give maximum power-factor correction. The efficiency of the motor may be neglected. Find:

- a. The combined power factor of original load and synchronous motor.
- b. Kilowatts available for compressing air.

27. A consumer with an average power load of 600 kw. at 60 per cent power factor lagging wishes to add a synchronous motor which will give a combined resultant power factor of 100 per cent and at the same time furnish all the mechanical output possible without exceeding the kilovolt-ampere rating of the original load.

- a. What would the kilovolt-ampere rating of the synchronous motor have to be to just accomplish this result?

- b. What other factors and considerations would you have to consider before making a final decision as to the size of motor you would install?

28. A 50-mi. transmission line has an average load of 6,000 kw. at 0.6 power factor lagging. To improve stability, voltage regulation, and efficiency it is desired to install a synchronous condenser at a substation near the receiving end. A synchronous condenser will have about 5 per cent losses and cost \$15 per kilovolt-ampere. Fixed charges including depreciation may be taken as 15 per cent. Transmission-line energy costs 1 ct. per kilowatt-hour delivered at the receiving end. Each 4 per cent increase in power factor may be taken as saving 1 per cent of the load energy. Will it pay to increase the transmission-line power factor to unity? Why?

29. A certain customer is limited by the size of his transformer bank to 1,000 kva. At present his load consists of 600 kw. at 0.6 power factor lagging. He wishes to add to this load an electric annealing furnace requiring 200 kw. at unity power factor.

- a. Determine the kilovolt-ampere rating of the smallest static condenser that will allow him to add this furnace without exceeding a total of 1,000 kva., if the losses of the condensers may be neglected.
- b. What is the resultant power factor of the combined loads?

30. A certain industrial load totals 600 kw. at 0.8 power factor lagging. By the addition of a 200 kva. (input rating) synchronous motor with an efficiency of 90 per cent, it is desired to correct the power factor of this load the greatest amount possible.

- a. What will be the resultant power factor of the combined load?
- b. If the original load is operated 100 hr. per month and the combined load 200 hr. per month, what will be the monthly energy bill according to the rate of 3 cts. per kilowatt-hour with the rate changing in inverse ratio with the average (arithmetical) power factor, 0.8 power factor to be considered as the base?
- c. Would it be possible to have any power output from the synchronous motor?

31. The power for a certain factory is furnished by a transformer bank rated at 1,000 kva. The average load is 600 kw. at 0.6 power factor lagging. A distribution engineer tells the manager of this factory that he can raise his power factor to 0.8 lagging and at the same time obtain 228 hp. in addition to what he has without overloading his present transformer bank if he will install the proper size overexcited synchronous motor. A motor of this size operating at this load may be assumed to have an efficiency of 0.85.

- a. Draw the circle diagram for the above conditions and verify the engineer's contention.
- b. What is the kilovolt-ampere rating of the synchronous motor required to accomplish the above result and at what leading power factor should it be operated?

32. The present average electrical power required by a consumer for a typical day of 8 hr. during 300 days per year is 707 kw. at 70.7 per cent lagging power factor. Energy can be purchased for 2 cts. per kilowatt-hour

discounted in inverse ratio of increase of power factor. Fixed charges are estimated at 15 per cent. It becomes necessary to install a 200-hp. motor to provide rated additional mechanical power during *one-half the above operating time*. The total load including the electrical input of the motor may be purchased at the same rate, taking advantage of possible average power-factor correction over the entire period.

- a. Which of the following installations is preferable? Why?
 - (1) A 200-hp. induction motor having an efficiency of 92 per cent and a power factor of 80 per cent lagging at a cost of \$10 of rated horsepower.
 - (2) Installation of the same motor with a static condenser to raise its power factor of 95 per cent at a total combined cost of motor and condenser of \$15 per horsepower of motor rating.
 - (3) A 200-hp. synchronous motor to operate full load for 4 hr. a day and 300 days per year at 100 per cent power factor and at zero power factor leading the remaining 4 hr. of the factory days. Such a motor has an average efficiency of 90 per cent, no-load losses of 5 per cent, and is estimated to cost \$12 per horsepower of rating.
 - b. System power factor at maximum correction.
 - (1) At what horsepower output should the motor in (3) above be operated to obtain maximum power-factor correction?
 - (2) What is the new system power factor?
 - c. The possibility of additional loads.
 - (1) Determine whether or not the existing transformer bank (rated at 1,000 kva.) will be sufficient to operate the factory as in (b).
 - (2) Can an additional lighting load be added? If so, how much?
 - (3) What will be the resulting system power factor after this lighting load is added?
- 33.** Place a circle around the letter T or F in front of the following statements according to whether you consider each of them to be true or false, respectively:
- T F A synchronous motor may be operated at a power factor of zero leading.
 - T F A synchronous motor may correct a low lagging power factor to the maximum extent and, in addition, deliver its full rating as mechanical power.
 - T F An induction motor can never correct a lagging power factor to the same extent as a synchronous motor upon the same system.
 - T F A load factor may exceed 100 per cent.
 - T F A diversity factor as large as 1.5 at the generating station would make it possible to have considerable less installed generating capacity than the sum of the connected loads on this station.
 - T F Power factor of the consumer's load may be improved and additional mechanical power provided simultaneously with one machine.
 - T F Power factor of the consumer's load may be improved without requiring additional useful power.
 - T F A diversity factor may be less than 100 per cent.

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- T F With an increasing load factor and a constant maximum demand, the consumer's average rate per kilowatt-hour of energy should increase.
- T F The maximum power-factor correction made possible by the use of a synchronous motor always occurs with the lowest possible leading motor power factor.
- T F The diversity factor of a number of different loads is the average of the individual demands over the demand of the combination.
- T F The demand factor can never be greater than 1.

CHAPTER XXVIII

RATE BASE AND RATE SCHEDULES

In the evolutionary period of what today are called public utilities, little, if any, governmental regulation affected the rates that were charged by these utilities. For instance, in the early days an individual or group of individuals might own and operate a toll bridge on the basis of what the "traffic would bear." That is, individual riders on horseback might be willing to pay a limited amount to cross the stream on a bridge, but if too high a price was charged a large proportion of them would undoubtedly prefer to swim their mounts across. If, because of local conditions, the amount that these riders would "bear" happened to return to the bridge owners 50 per cent or more on the dollar invested over and above all expenses, no one objected. In other words, there was no relation between the investment and the rate of return. The only check on the rates charged was the law of diminishing returns.

Another form of this same principle called the "value of service" was sometimes used. At flood season a horseback rider might be willing to pay more to cross the bridge than under normal times, and in winter more than in summer. In like manner, a merchant with a wagonload of perishable goods might conceivably pay more to cross on a bridge than would an individual rider.

It is obvious that, as long as there was no competition, our toll-bridge owners found that the traffic would bear more, or the value of their particular service was higher, than when others were in competition with the same or a similar service. Thus, if the bridge had been erected near an older flat-bottomed ferry, the service rendered by the bridge would have been only the saving of time and the owners would undoubtedly find that the traffic would "bear" less, as the value of their service would be lower.

Some of the great individual fortunes accumulated in past decades in the public utility field were possible largely because a fair proportion of the "traffic" was willing to "bear" to a considerable degree. Occasionally abuses resulted from the unregulated application of the "what the traffic will bear" principle. Suppose that in our toll-bridge example the nature of the terrain was such that only one location for a bridge was possible and that ferries or other means of crossing were totally impracticable. The toll-bridge owners then would have had a natural monopoly and, if inclined to be unreasonable or unethical, might have charged exorbitant rates. For those who were able and willing to pay there was perhaps no lasting harm, but for those who could not afford it and those who needed the service there resulted a great hardship.

Moreover, there was latent in this situation a possibility for the toll-bridge operators to employ a form of extortion or at least discrimination. They might, for instance, put a certain individual out of business by charging him excessive rates while charging his competitor a much lower rate. This the bridge owners might have done to gain favorable political legislation for their enterprise or merely for financial gain.

Even such operators as these found in time that the American public, in general, has a limit to what it will "bear," and there came into existence both state and federal commissions* whose primary object was to regulate the rates charged by public utilities. As is frequently the case, the pendulum probably swung too far and to some extent stifled the normal healthy growth of these industries. Even granting that regulation has not always been what it should be, it is generally conceded that today, when nearly all public utilities are monopolies, either created thus naturally or by legislation, governmental rate regulation is a necessity.

Even before regulation became the rule rather than the exception, some of the more progressive and farsighted utility operators realized that the methods just discussed for establishing rates were both illogical and unscientific. Thus there came into being the principle that rates should be based on the "cost of service."

* See Chap. XXV

Although fundamentally sound, this principle entails many difficulties in its application. As discussed in Chaps. IX, X, and XI, it involves establishing a valuation upon which costs are based. Thus some reference value, usually characterized as a "rate base," must be definitely established for each regulated public utility before the justifiable net income, dependent gross revenue, and resultant rate can be calculated. The approval of regulatory commissions and courts has been very generally established for a "fair return" or "net income" which the utility may earn, over and above reasonable operating expenses and fixed charges, but inclusive of bond interest and dividends. Such a "fair return" is most effectively expressed as a percentage of the rate base. This rate base, therefore, is a certain value or worth of the company which results from the inventory and appraisal previously discussed. It is supposed to represent only the value that is actually "used and useful" in the public service. If and when such a value has been established, and a definite percentage thereof has been predetermined and approved by the commission, let us say 7 per cent for example, then the annual gross revenue, which may be secured from all the classes of consumers for whom such a value has been established, includes the items of the following formula:

Gross revenue = 7 per cent \times rate base + annual (operating expenses + taxes + depreciation reserve + insurance + incidental approved overhead charges, such as reserves for employees' injuries and damages).

Thus, it will be seen that the rate base, creating as it does a fairly large and possibly widely variable portion of the gross revenue, is a very important value which must be accurately, or at least equitably and justifiably, established.

However, if the commission, in its leniency toward the particular public utility, swings too far in the direction of allowances for tangible values, if it is inclined to include capitalization that does not represent "fair value," if it tends to capitalize past earnings, when large, if it considers past net incomes, previous to regulation, which did not equal the present allowable percentage return upon investment, or if these items are too generously allowed, it should be noted that the present and future consumers will be required to pay for past weaknesses of

administration in which they have never been and should not be involved.

Furthermore, if net income is to be expressed as a fixed percentage of the rate-base valuation and this rate-base valuation is, in turn, calculated as capitalized earnings, such as the $\$12,000/0.06 = \$200,000$ value illustrated in Chap. IX, is it not clear that this argument, in the form of a boomerang, brings one back to a still more padded net income and newly augmented rate base; thus, like "the house that Jack built," greater net income makes greater valuation, and greater valuation, in turn, provides a still greater possible income, with its increased dependent gross revenue and affiliated rate schedule?

Let us suppose that an appropriate valuation has been arrived at by some one of the approved methods discussed in Chap. XI and that for a certain utility a figure of \$50,000,000 has been approved by the commission or court having proper jurisdiction. This figure is the so-called rate base and it is upon this figure that a fair return is determined. With an allowable fair return of 7 per cent of the rate base, the net income of this company would be \$3,500,000. Suppose further that the operating expense is \$4,000,000 and that taxes, depreciation, insurance, etc., amount to \$500,000; then, using the formula given above,

$$\begin{aligned}\text{Gross revenue} &= \$3,500,000 + \$4,000,000 + \$500,000 \\ &= \$8,000,000\end{aligned}$$

This company is entitled to a gross income of \$8,000,000 and to a rate schedule or rate schedules which in normal times will bring in this amount of money from the consumers it serves.

Such a company as the one assumed above would be made up of a number of groups of consumers, each of which may contain several classes and each class many individuals. Each such group would, because of the character of its demand and energy requirements, have different costs of service. In order to carry out the cost-of-service principle, it is, therefore, necessary to allocate the \$8,000,000 of gross revenue to the various groups in the ratio of the actual cost to the utility of each group.

In the case of light and power utilities these costs may be divided into two parts, demand costs and energy costs. The demand portion contains those costs that are due to the size of the plant, such as fixed charges, and are nearly independent of

the amount of energy generated. The second part is comprised largely of the actual operating expenses, such as the cost of coal consumed.

If the above company has four groups of consumers which use all the demand and all the energy output of the company, it is necessary to break down or allocate the total costs according to the cost of serving each of these groups. Information for making such an allotment may be obtained from the books of the company, particularly if a recent appraisal has been made and proper cost accounts have been kept. As a typical example, consider the following to be such an allocation of the \$50,000,000 plant with a \$8,000,000 gross revenue under consideration.

TABLE LX.—ALLOCATION OF GROSS REVENUE TO VARIOUS CONSUMER GROUPS

Group	Per cent valuation	Per cent gross revenue	Per cent gross revenue chargeable to		
			Demand	Energy	Total
Commercial light and power.....	21.2	23	34.3	+ 65.7 = 100	
Railway.....	14	15	42	+ 58 = 100	
Residential.....	51	47	67	+ 33 = 100	
Street lighting.....	13.8	15	0	+ 100 = 100	
Total.....	100	100			

In this case the commercial light and power group will carry $\$8,000,000 \times 0.23 \times 0.343 = \$632,000$ of demand charges and $\$8,000,000 \times 0.23 \times 0.657 = \$1,210,000$ of energy charges.

Allocating energy charges to the various classes within a group presents no difficult problem as it can be done on a strict energy basis. The allocation of the demand charges, if properly done, is a much more complicated process.

The various methods available for making such an allocation, with their advantages and disadvantages, were discussed in considerable detail in Chap. XVIII. Referring to the figures in that chapter and assuming that the phantom-consumer method had been used, Class B of the commercial light and power group would carry \$175,888 of demand charges and

$$\$1,210,000 \times 14,016,000 / 86,724,000 = \$195,000$$

of energy charges.

The two figures thus determined are the two that must be known in order to prepare a suitable rate schedule for the individual consumers in Class B of the commercial light and power group. It is a roundabout process from the starting point, namely, the rate base of \$50,000,000. To proceed by the method in this and the preceding chapters involves considerable complication and necessitates a great many records from which to obtain the necessary information. Yet, if the individual consumers in Class B are to be charged on the basis of the cost of serving them with the service they require, there can be no other alternative.

The cost-of-service principle may be carried on down to the individual consumer within the class by the proper form of rate schedule.

The basic form of a rate schedule may be expressed by the following formula:

$$Ax + By + C = \text{bill}$$

where Ax = demand charge.

By = energy charge.

C = customer's charge.

A = rate per unit of demand (kw., hp., kva., etc.)

B = rate per unit of energy (kw.-hr.)

C = fixed sum equal to individual's billing and metering expense.

x = number of kilowatts, horsepower, etc., in the billing period.

y = number of kilowatt-hours consumed in the billing period.

If all three terms are used in a given rate schedule, it is said to be a three-charge rate. This rate was first proposed by Mr. Henry L. Doherty in 1900 and for that reason is sometimes referred to as a Doherty rate.

If the C term is omitted, a two-charge rate results. The earliest form of this rate was introduced by Dr. John Hopkinson in 1892 and is frequently called a Hopkinson rate. Another form of a two-charge rate which recognized the importance of load-factor conditions and introduced the demand costs through

initial high rates per kilowatt-hour for a certain number of hours' use of the customer's maximum demand was introduced by Mr. Arthur Wright in 1896. Both of these types will be discussed later.

Finally, if both the *A* and *C* terms are omitted, there results a single-charge rate. It is obvious that, if a single-charge rate is used, the principle of allocated costs is not carried down to the individual consumer, and demand, energy, and customer's expense charges must be lumped together and collected as a single charge per unit of energy.

Any of the above rates may be straight line, stepped, or blocked. A single charge, straight line or flat rate, is the simplest of all rates and consists of a constant price charge per unit, such as 5 cts. per kilowatt-hour for all energy used. Such a rate does not attempt to allocate costs to the individual consumer nor does it recognize the principle of quantity discount. For this reason, it is not used extensively except for municipal street lighting, where the number and size of lamps and the time during which they are to be operated are known in advance. For the latter case, the customary form is: \$75 per year per 1,000 watt lamps for 4,000 hr. use.

To step a rate, the charges are scaled down as the consumption increases, thereby recognizing the reduction in cost resulting from quantity consumption. However, the entire consumption of a given customer is charged at the step of the rate into which that consumption falls. In other words, the various steps in the rate are not additive. The usual form of a step rate is as follows:

10 cts. per kilowatt-hour for from 1 to 25 kw.-hr. used per month.
8 cts. per kilowatt-hour for from 26 to 50 kw.-hr. used per month.
6 cts. per kilowatt-hour for from 51 to 100 kw.-hr. used per month.
4 cts. per kilowatt-hour for from 101 or more kw.-hr. used per month.

Assume a consumer whose consumption is 65 kw.-hr. in some month. Then, using the above rate schedule, this customer's bill for that particular month would be $65 \times 0.06 = \$3.90$.

Such a rate schedule is apt to encourage the wasting of energy. If such a customer had a consumption of around 48 kw.-hr., he would save money by turning on lights to raise his consumption into the next step. Because of this inherent defect in the step rate, it is practically obsolete. In fact, in many states its use is actually prohibited by the state commission.

The same principle is applied to a rate schedule without the drawback of the step rate if the schedule is blocked. A block rate is additive and, therefore, no matter how large a consumption a customer may have, his bill is figured progressively through all the blocks preceding the one in which his consumption lies. The customary form is as follows:

10 cts. per kilowatt-hour for the first 25 kw.-hr. used per month.

8 cts. per kilowatt-hour for the next 25 kw.-hr. used per month.

6 cts. per kilowatt-hour for the next 50 kw.-hr. used per month.

4 cts. per kilowatt-hour for the excess over 100 kw.-hr. used per month.

With this rate, the customer above would receive a bill figured as follows:

$$25 \times 0.10 = \$2.50$$

$$25 \times 0.08 = 2.00$$

$$15 \times 0.06 = 0.90$$

$$65 \text{ at } \$5.40$$

$$\text{Average rate} = 8\frac{1}{3} \text{ cts.}$$

This customer paid an average rate of $8\frac{1}{3}$ cts. while a customer with only a consumption of 20 kw.-hr. would pay an average rate of 10 cts. It is obvious that burning lights simply to raise consumption will not reduce the total bill, as in the case of the step rate. Yet, consumers with large consumptions obtain a lower average rate than those with small consumptions. They must, however, progress through each block in turn in order to realize the lower average rate. In other words, the rate is additive.

In the two- or three-charge rates, either the demand or the energy portion or both may be blocked. For example, consider a Hopkinson rate consisting of a demand charge, expressed in

dollars per unit of demand or connected load, such as the kilowatt or horse power, plus an energy charge expressed in cents per kilowatt-hour. A typical form follows with both portions blocked:

Demand Charge:

\$2.50 per month per kilowatt for the first 50 kw. of the maximum demand in the month.

\$2.00 per month per kilowatt for the excess of the maximum demand over 50 kw.

Plus an Energy Charge of:

4 cts. per kilowatt-hour for the first 1,000 kw.-hr. used per month.

2 cts. per kilowatt-hour for the next 4,000 kw.-hr. used per month.

1 ct. per kilowatt-hour for the excess over 5 000 kilowatt-hours used per month.

Assume a factory having a maximum demand of 80 kw. and a consumption of 8,000 kw.-hr. The power and light bill for the month in question would be figured as follows:

Demand Charge:

$$50 \times \$2.50 = \$125.00$$

$$30 \times 2.00 = 60.00$$

$$\begin{array}{r} 80 \text{ at} \\ \$185.00 \end{array}$$

Energy Charge:

$$1,000 \times 0.04 = \$40.00$$

$$4,000 \times 0.02 = 80.00$$

$$3,000 \times 0.01 = 30.00$$

$$\begin{array}{r} 8,000 \text{ at} \\ \$150.00 \end{array}$$

$$\begin{array}{r} \text{Total bill.....} \\ \$335.00 \end{array}$$

In a Hopkinson rate, maximum demand may be either estimated or metered, but in this type of rate the latter is more common. It finds its greatest application for large industrial or commercial consumers where the terms kilowatt and kilowatt-

hour are more apt to be understood and where the more expensive and complicated metering equipment can be justified.

Another rate, similar in principle, but which is based on a single unit, i.e., the kilowatt-hour, is the Wright rate. In the Wright rate it is assumed that a consumer will, as an average, use his maximum demand 1, 2, or 3 hr. per day as desired. This would result in 30, 60, or 90 hr. use of maximum demand per month, respectively. Here, too, the demand may be estimated or metered and the hours of use chosen to best suit the actual conditions. It is more common to estimate the demand in the case of a Wright rate than it was in the Hopkinson rate.

The customary form follows:

10 cts. per kilowatt-hour for electricity used equivalent to, or less than, the first 30 hr. use per month of the maximum demand.

5 cts. per kilowatt-hour for additional electricity used equivalent to, or less than, the next 30 hr. use per month of the maximum demand.

2 cts. per kilowatt-hour for electricity used per month in excess of the equivalent of 60 hr. use of the maximum demand.

Assume a consumer with an estimated demand of 800 watts and a monthly consumption of 50 kw.-hr. His bill would then be figured as follows:

Thirty hours use of 800 watts equals 24 kw.-hr.

$$24 \times 0.10 = \$2.40$$

$$24 \times 0.05 = 1.20$$

$$2 \times 0.02 = 0.04$$

50 at	\$3.64
-------	---------------

To illustrate the effect of a large demand coupled with a small consumption, consider a customer whose demand is 2 kw. and whose consumption is 100 kw.-hr. per month. Here, 30 hr. use of the maximum demands is 60 kw.-hr. and the bill would be:

$$60 \times 0.10 = \$6.00$$

$$40 \times 0.05 = 2.00$$

100 at	\$8.00
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This particular Wright rate is blocked. This is not essential, of course, but there are always two parts consisting of a statement covering both demand and energy portions of the monthly bill. The rate for the first part is usually one and one-half to three times the rate in the last part, as the first part is designed to collect all the demand costs.

As an example of a Doherty three-charge rate, consider the following:

Demand Charge:

\$3.00 per month per kilowatt for the first 25 kw. of maximum demand in the month.

\$2.00 per month per kilowatt for the excess of the maximum demand over 25 kw.

Plus an Energy Charge of:

3 cts. per kilowatt-hour for the first 1,000 kw.-hr. used per month.

1 ct. per kilowatt-hour for the excess over 1,000 kw.-hr. used per month.

Plus a Customer Charge of:

75 cts. per month per meter.

Assume a consumer with a demand of 100 kw. and a consumption of 8,000 kw.-hr. This consumer's bill would be:

Demand Charge:

$$25 \times \$3.00 = \$ 75.00$$

$$75 \times 2.00 = 150.00$$

100 at	\$225.00
--------	----------

Energy Charge:

$$1,000 \times 0.03 = \$30.00$$

$$7,000 \times 0.01 = 70.00$$

8,000 at	\$100.00
----------	----------

Customer Charge:

1 meter at \$0.75	0.75
Total bill.....	\$325.75

It should be noted that in the event that this customer did not use any electricity whatsoever, he would still receive a bill of 75 cts. provided he still was connected to the distribution system of the public utility company.

All these typical rate forms are subject, in actual practice, to numerous modifications. In some cases, this may be done to such an extent that the basic form is hardly recognized. Moreover, the figures chosen in these illustrations are not to be considered as universal, but are used simply for demonstration purposes. They do represent, however, values frequently found in actual rate schedules.

Any rate schedule of any form may have added to it one or more clauses giving discounts for improvement in load conditions, thereby reducing the actual cost of service, or for the promotional purposes of improving station load or power factors. Some of the more common are listed below.

1. *Minimum Charge, Say \$1.*—This charge is similar to a customer charge in a three-charge rate with one important exception.

If, in any one month, the total bill exceeds the minimum charge, that charge is not added to the bill as is a customer charge. If the total bill is less than the minimum charge, the minimum charge determines the bill and any energy cost less than the minimum charge is not figured.

2. *Prompt-payment Discount, Say 10 Per Cent, Ten Days.*—This discount is usually figured on the total bill in excess of the minimum charge for payments made within ten days.

3. *Coal Clause.*—A coal clause is sometimes employed to take care of fluctuations in the price or quality of coal. It is customarily applied only to the energy portion of the rate schedule and raises or lowers the unit rate according to whether the price of coal goes up or down. To be complete, such a clause should include the B.t.u. content of the coal as well as its price. Such a coal clause might be worded as follows:

"The energy charge is increased or decreased 0.0197 cts. per kilowatt-hour for each 1 ct. increase above or decrease below 16.208 cts. per million B.t.u. when the average cost of fuel is more than 16.708 cts. or less than 15.708 cts. per million B.t.u. Such increase or decrease will be applied to the average portion of the kilowatt-hours delivered from steam-generating sources."

More commonly the following form is used:

"For all consumption in excess of 500,000 kw.-hr. the energy charge is increased or decreased by 0.001 ct. per kilowatt-hour for each 1-ct. increase above \$4.50 or decrease below \$3.50 per short ton in cost of coal of 10,500 B.t.u. per pound.

4. *Power-factor Clause*.—This clause operates customarily upon the demand portion of the rate schedule, either to raise or to lower the actual demand for billing purposes according to whether the power factor is below or above some predetermined average value, respectively. For example:

"The billing demand shall be corrected to 85 per cent power factor by multiplying the measured demand by 85 and dividing the product by the actual power factor expressed in per cent."

5. Other clauses and discounts less frequently used and usually of local or special application are the following:

- | | |
|----------------------------|--------------------------|
| a. Lamp service. | f. Off-peak discount. |
| b. Seasonal power clauses. | g. Primary discount. |
| c. Connection charge. | h. Flasher discount. |
| d. Extension clause. | i. Transformer discount. |
| e. Rural clause. | j. Load-factor discount. |

Having now discussed the types of rate schedules most frequently available we may return at this point to the original problem of the \$50,000,000 company with a gross revenue of \$8,000,000. The problem was left temporarily, the reader will remember, with the allocation to Class B of the commercial light and power group of: \$175,880 of annual demand charges, \$195,000 of annual energy charges based upon a class maximum demand of 7,200 kw., and an annual consumption of 14,016,000 kw.-hr. On a monthly basis, these figures are respectively \$14,656, \$16,250, and 7,200 kw. and 1,160,000 kw.-hr.

From typical consumer-load-distribution tables of this or a similar company, we may prepare Table LXI, which gives a close approximation of the number of customers in Class B and their load distribution.

TABLE LXI.—CLASS B CUSTOMERS AND THEIR LOAD DISTRIBUTION

Number of consumers	Maximum demand, kw. each	Energy per month, kw.-hr.
1,700	2	80,000
4,000	1	360,000
3,400	1.5	408,000
600	1	312,000
9,700	...	1,160,000

Suppose that a Hopkinson rate is desired for Class B consumers. The first step is to determine an average figure to act as a guidepost. The class maximum demand was from Table XXXI, Chap. XVIII, 7,200 kw. If we assume a diversity factor of 1.4, the summation of maximum demands of the customers in the class is $7,200 \times 1.4 = 10,080$ kw. and the average figure is $\$14,656/10,080 = \1.45 per kilowatt of maximum demand. With a starting point of this \$1.45, the remaining process is one of trial and error, as indicated below, until the correct figure for the particular distribution of Table LXI above is obtained.

Using \$1.45 as a basis, the above group of customers would yield the following income for the demand portion of the Hopkinson rate:

$$\begin{aligned}
 \$1,700 \times 2 &\times \$1.45 = \$ 4,930 \\
 4,000 \times 1 &\times 1.45 = 5,800 \\
 3,400 \times 1.5 &\times 1.45 = 7,395 \\
 600 \times 1 &\times 1.45 = 870 \\
 \\
 \hline
 && \$18,995
 \end{aligned}$$

Practically 19,000 is entirely too much. It is obvious, therefore, that the diversity factor is much larger than that assumed. Suppose that for the next trial \$1 is used. Then:

$$\begin{aligned}
 \$1,700 \times 2 &\times \$1.00 = \$ 3,400 \\
 4,000 \times 1 &\times 1.00 = 4,000 \\
 3,400 \times 1.5 &\times 1.00 = 5,100 \\
 600 \times 1 &\times 1.00 = 600 \\
 \\
 \hline
 && \$13,100
 \end{aligned}$$

Now, since the desired value of \$14,656 has been bracketed, the true value lies in between \$1.45 and \$1.00, and nearer \$1.00. Try, for instance, \$1.12.

$$\begin{array}{rcl}
 \$1,700 \times 2 & \times \$1.12 = & \$ 3,808 \\
 4,000 \times 1 & \times 1.12 = & 4,480 \\
 3,400 \times 1.5 & \times 1.12 = & 5,712 \\
 600 \times 1 & \times 1.12 = & 672 \\
 \\
 & & \hline \\
 & & \$14,672
 \end{array}$$

This is close enough and we can adopt the figure of \$1.12 per kilowatt for the demand portion of the Hopkinson rate.

The energy portion is handled in a similar way. The average figure is

$$\frac{\$16,250}{1,160,000} = 1.4 \text{ cts. per kilowatt-hour}$$

If it is desired to block this portion of the rate schedule, it is necessary to decide on both the rate scale and the number and magnitude of the blocks. In the case of the latter, we may proceed by dividing the kilowatt-hours in the last column of Table LXI by the number of customers in order to get each customer's consumption. The results are 47, 90, 120, and 520, respectively. Thus blocks of 50, 50, and all over 100 look about right, as the first group will all be in the first block and the last group practically all in the last block. With an average figure of 1.4 cts., none of the block rates can be very large. Try 2, $1\frac{1}{2}$, and $\frac{3}{2}$ cts., respectively:

Then

$$\begin{array}{rcl}
 \$1,700 \times 47 \times \$0.02 = & \$ 1,598 \\
 8,000 \times 50 \times 0.02 = & 8,000 \\
 4,000 \times 40 \times 0.015 = & 2,400 \\
 4,000 \times 50 \times 0.015 = & 3,000 \\
 3,400 \times 20 \times 0.005 = & 340 \\
 600 \times 420 \times 0.005 = & 1,260 \\
 \\
 & & \hline \\
 & & \$16,598
 \end{array}$$

This figure is close enough. The calculation is made by noting that 1,700 customers with 47 kw.-hr. consumption do not get out

of the first block of 50 kw.-hr. All the others, totalling 8,000, go through the first block. The second group of 4,000 customers have $90 - 50 = 40$ kw.-hr. in the second block. The third and fourth groups of customers, totaling 4,000, go through the second block, and of this number 3,400 of them have $120 - 100 = 20$ kw.-hr. in the third block. The last group of 600 have $520 - 100 = 420$ kw.-hr. in the last block.

The final rate schedule, as just determined, will, therefore, read as follows:

Demand Charge:

\$1.12 per month per kilowatt of maximum demand in the month.

Plus an Energy Charge of:

2 cts. per kilowatt-hour for the first 50 kw.-hr. used per month.

1½ cts. per kilowatt-hour for the next 50 kw.-hr. used per month.

½ ct. per kilowatt-hour for the excess over 100 kw.-hr. used per month.

If it had been desired to prepare a Wright rate instead of a Hopkinson rate, a slightly different method of attack would have been necessary. Since 30 hr. use of maximum demand is the most common, that figure will be used. From Table LXI the number of hours' use of maximum demand that will be available from the Class B customers can be calculated as follows:

Kw.-hr.
$1,700 \times 2 \times 30 = 102,000$
$4,000 \times 1 \times 30 = 120,000$
$3,400 \times 1.5 \times 30 = 153,000$
$600 \times 1 \times 30 = 18,000$
393,000

Thus, $\$14,656/393,000 = 3.7$ cts. is the average rate for the demand portion. The excess is figured as follows:

The first group of 1,700 has no excess.

The second group of 4,000 has

	Kw.-hr.
360,000 (Table LXI) - 120,000	= 240,000
The third group of 3,400 has	408,000 - 153,000 = 255,000
The fourth group of 600 has	312,000 - 18,000 = 294,000
Total.....	789,000

The rate for the energy portion then is:

$$\frac{\$16,250}{789,000} = 2.06 \text{ cts. per kw-hr.}$$

For the first trial, 4 and 2 cts., respectively, look as if they might work. Thus, one would obtain:

$$\begin{array}{r} 393,000 \times \$0.04 = \$15,720 \\ 789,000 \times \$0.02 = 15,780 \\ \hline \text{Total.....} & \$31,500 \end{array}$$

One would need:

$$\begin{array}{r} \$14,656 \\ 16,250 \\ \hline \$30,906 \end{array}$$

The result is only \$600 over that needed and, rather than use odd fractions of a cent, it would be considered close enough.

The Wright rate would then read:

4 cts. per kilowatt-hour for electricity used equivalent to, or less than, the first 30 hr. use per month of the maximum demand.

2 cts. per kilowatt-hour for electricity used per month in excess of the equivalent of 30 hr. use of the maximum demand.

As previously stated, the maximum demand of a consumer may be either estimated or metered. If estimated, a number of methods are in common use.

1. Some percentage of the connected load ranging all the way from 50 to 100 per cent is very common. Such percentages are

called demand factors and may be found for typical classes of service in various Handbooks.*

2. A variation that is sometimes used is 100 per cent of all appliances plus 80 per cent of the first 10 horsepower of motors, plus 50 per cent of the excess horsepower of motors.

3. Some power companies prepare a table of appliances in which the demands of such apparatus are listed.

4. Floor area of active rooms is sometimes used.

5. Actual room count is a variation of No. 4.

6. Power per socket, such as 60 watts per socket is another common method.

In most cases, where demand is estimated, the company reserves the right at its option actually to meter the demand.

If the demand is to be metered, the block-interval-demand meter is by far the most common. Such a meter may be either of the indicating or graphic type and can be arranged to record the demand every 15, 30, or 60 min. as desired. If the graphic type is used, the time at which the maximum demand occurred is also obtained.

In Canada and the border cities, such as Detroit, thermal-demand meters are more numerous.

When a rate schedule contains a power-factor clause, and that clause is enforced, the customers' power factor is usually determined by one of the following methods: To meter power factor, two meters are customarily required, one recording reactive kilowatt-hours and the other actual kilowatt-hours of energy. From these two meters the weighted average power factor may be calculated. If the power factor *at the time of maximum demand* is required, maximum-demand indicators must be furnished with each meter or graphic attachments must be supplied. In either event, such an installation is expensive.

The measurement of the kilovolt-ampere demand is even less common and requires a still more expensive metering installation.

It should be emphasized again that the figures expressed in this chapter are not to be considered as standard, or necessarily correct for any particular locality, but are used merely as illustrations. Rates may justly vary widely in different localities and no standard rate is possible of expression. Each case must be made an object of special local study in order to determine a mutually equitable charge.

* See Chap. XXVII.

General References

1. NASH, L. R.: "Public Utility Rate Structures," McGraw-Hill Book Company, Inc., New York.
2. BARNES, IRSTON R.: "Cases on Public Utility Regulation," Edwards Brothers, Inc., Ann Arbor, Mich.
3. DORAU, HERBERT B.: "Materials for the Study of Public Utility Economics," The Macmillan Company, New York.
4. CABOTT, PHILIP, and DEANE W. MALOTT: "Problems in Public Utility Management," McGraw-Hill Book Company, Inc., New York.
5. "N.E.L.A. Rate Book (1931)," National Electric Light Association, New York.

Review Problems

LIST I

1. A large midwestern utility has the following general service rate in force:

Rate.—For the service requested, the customer agrees to pay the company as follows:

- 9 cts. per kilowatt-hour for electricity used equivalent to or less than the first 30 hr. use per month of the maximum demand in the month.
- 6 cts. per kilowatt-hour for additional electricity used equivalent to or less than the next 30 hr. use per month of the maximum demand.
- 3 cts. per kilowatt-hour for all electricity used per month in excess of the equivalent of 60 hr. use of the maximum demand.

Determination of Maximum Demand.—The customer's maximum demand shall be ascertained in accordance with the company's schedule in the following table.

A. The figures in column *A* of the table designate the rated capacity, in watts, of installation connected.

B. The figures in column *B* of the table designate the number of kilowatts of maximum demand.

<i>A,</i> Rated Capacity, Watts	<i>B,</i> Maximum Demand, Kw.
Up to 125.....	0.1
126 to 250.....	0.2
251 to 375.....	0.3
376 to 525.....	0.4
526 to 675.....	0.5
676 to 825.....	0.6
826 to 975.....	0.7
976 to 1,125.....	0.8
1,126 to 1,275.....	0.9
1,276 to 1,425.....	1.0
1,426 to 1,500.....	1.1

Monthly Bills. Prompt-payment Discount.—As soon as practicable after the end of each month the company shall render a bill to the customer for the amount due hereunder for such month and the customer agrees to pay such bill within ten days after its date; and if such bill be paid within such ten days the customer shall be entitled to a discount of 1 cent per kilowatt-hour from that part of any monthly bill represented by charges under the first two portions of the rate.

Minimum Charge.—Fifty cents per month per meter, except that, where a portion of the connected installation is power apparatus (other than any household utensil having a rated capacity of 660 watts or less), the minimum charge shall be 50 cts. per month for each horsepower, or fraction thereof, of the total rated capacity of such power apparatus.

Determine the monthly bill for each of the following customers:

- a. Customer *A* has a connected load of 1,050 watts and his kilowatt-hour meter read 215 kw.-hr. Bill was paid five days after receiving it.
 - b. Customer *B* has a connected load of 1,500 watts including a $1\frac{1}{2}$ -hp. motor in his basement and his meter read 10 kw.-hr. Bill paid eight days after receiving it.
 - c. Customer *C* has a connected load of 530 watts and his kilowatt-hour meter read 25 kw.-hr. Bill paid twelve days after receiving it.
 - d. Customer *D* has a connected load of 1,450 watts including a 1-hp. motor, and his meter read 10 kw.-hr. Bill paid six days after receiving it.
 - e. Customer *E* has a connected load of 1,375 watts and his meter read 576 kw.-hr. Bill paid three days after receiving it.
2. A large midwestern utility has the following general power rate in force. This company is paying on the average \$4 per ton for 10,500 B.t.u. coal.

Rate. Demand Charge.—The customer agrees to pay to the company for each month during the life hereof a demand charge monthly, in accordance with the following schedule:

Monthly:

\$2.00 per month per kilowatt for the first 200 kw. of the number of kilowatts constituting the basis for the demand charge for the month, ascertained in the manner hereinafter provided.

\$1.75 per month per kilowatt for the next 800 kw. of the number of kilowatts constituting the basis for the demand charge for the month.

\$1.40 per month per kilowatt for the excess, if any, over 1,000 kw., of the number of kilowatts constituting the basis for the demand charge for the month.

Energy Charge.—In addition to the demand charge, the customer also agrees to pay to the company an energy charge for each month, based upon the number of kilowatt-hours actually used in such month, which energy charge shall be in accordance with the following schedule:

2.6 cts. per kilowatt-hour for the first 6,000 kw.-hr. used in the month.

1.1 cts. per kilowatt-hour for the next 24,000 kw.-hr. used in the month.

0.9 cts. per kilowatt-hour for the next 70,000 kw.-hr. used in the month.

0.45 ct. per kilowatt-hour for the next 400,000 kw.-hr. used in the month.
 0.38 ct. per kilowatt-hour for all electricity used in the month in excess
 of 500,000 kw.-hr.

Coal Clause. The energy charge for each kilowatt-hour of electricity in excess of 100,000 kw.-hr. supplied in any month under this contract is based on the cost of fuel to the company, determined as hereinafter provided:

$$\frac{\text{Cost of coal per ton} \times 100,000}{2,000 \times \text{B.t.u. per lb. of coal}} = \text{cost per therm in cents}$$

Should the average cost per therm in any month be below 1.45 cts., the customer shall be entitled to a credit for each kilowatt-hour of electricity in excess of 100,000 kw.-hr. used at the rate of 0.0015 ct. per kilowatt-hour for each decrease of 0.01 ct. in the cost of fuel per therm below 1.60 cts. per therm; if the cost per therm shall be in excess of 1.75 cts. per therm, then the customer shall pay an additional sum for each kilowatt-hour of electricity in excess of 100,000 kw.-hr. used at the rate of 0.0015 ct. per kilowatt-hour for each increase of 0.01 ct. in the cost of fuel per therm above 1.60 cts. per therm. When the total cost is between the limits of 1.45 cts. per therm and 1.75 cts. per them, there shall be no correction in the charge per kilowatt-hour.

Determination of Maximum Demand.—The customer's maximum demand will be determined by maximum-demand instruments.

Monthly Bills. Prompt-payment Discount.—As soon as practicable, after the end of each month, the company shall render a bill to the customer for the amount due hereunder for such month, and the customer agrees to pay such bill within ten days after its date, and, if such bill be paid within such ten days, the customer shall be entitled to a discount from the amount of the bill equal to 10 per cent of the total amount of the energy charges for the first 100,000 kw.-hr. only, used in the month.

Power Factor.—The company reserves the right to make monthly tests to determine the power factor of the customer's installation served hereunder. Measurement will be made at the point where the electricity is metered, and, if in any month such power factor (which shall be the average power factor under normal operating conditions) is found to be less than 85 per cent, the customer shall pay to the company for such month an additional amount equivalent to 1 per cent of the demand charge (ascertained for the month as above provided) for every 1 per cent or fraction thereof that such power factor is less than 85 per cent.

Minimum Charge.—Where the demand charge is on a monthly basis, the customer agrees to pay for each month a demand charge of not less than \$50 (being \$2 per kilowatt reckoned upon 25 kw.).

The ABC Manufacturing Company's meters record the following for the month of January.

Energy	125,762 kw-hr.
Maximum demand.....	218 kw.
Average power factor.....	80 per cent

The bill was paid five days after it was received.

- a. Determine the amount of the bill the *ABC* Manufacturing Company received for January's light and power.
3. Another large utility in the Middle West has the following large power-rate schedule:

Rate:

Demand Charge:

- \$2.50 per kilowatt for the first 10 kw. of demand per month.
- \$2.00 per kilowatt for the next 15 kw. of demand per month.
- \$1.50 per kilowatt for the next 25 kw. of demand per month.
- \$1.35 per kilowatt for the next 50 kw. of demand per month.
- \$1.25 per kilowatt for all in excess of 100 kw. of demand per month.

Energy Charge:

- 3.0 cts. per kilowatt-hour for the first 5,000 kw.-hr. per month.
- 2.0 cts. per kilowatt-hour for the next 5,000 kw.-hr. per month.
- 1.2 cts. per kilowatt-hour for the next 10,000 kw.-hr. per month.
- 1.0 ct. per kilowatt-hour for the next 30,000 kw.-hr. per month.
- 0.9 ct. per kilowatt-hour for all in excess of 50,000 kw.-hr. per month.

Determination of Demand.—By measurement of the highest 15-min. interval monthly.

Power Factor.—The demand for billing purposes is increased or decreased 1 per cent for each 1 per cent the average power factor is below 80 per cent lagging or above 90 per cent lagging.

Primary Discount.—Five per cent of the energy charge in one month if energy is metered at line voltage of 2,300 volts.

Transformer Discount.—Ten per cent of the demand charge where energy is metered at or above 2,300 volts and where the customer furnishes and maintains all transformer equipment.

Load-factor Discount.—Three-tenths cent per kilowatt-hour from the energy charge for the portion of the kilowatt-hours in excess of 200 hr. use of the maximum demand.

Off-peak Discount.—Forty per cent of demand charge during any one month if the demand between 3:30 P.M. and 8:30 P.M. on any week day in that month, if between November and March inclusive, does not exceed 10 per cent of the highest demand during the preceding twelve months.

Minimum Charge.—The demand charge for not less than 80 per cent of the highest billing demand of the preceding twelve months.

The *XYZ* Manufacturing Company has the following meter readings for the month of January:

Maximum demand.....	225 kw.
Energy.....	86,253 kw.-hr.
Average power factor.....	94 per cent
Maximum demand between 3:30 P.M. and 8:30 P.M.	23 kw.
Maximum demand preceding 12 months....	275 kw.

This customer has primary metering and maintains its own transformer substation. Bill always paid within five days after date thereof.

- a. Determine the XYZ Manufacturing Company's bill for January.
4. A large midwestern utility has the following residential rate in force:
Rate.—For the service requested, the customer agrees to pay the company as follows:

- 8 cts. per kilowatt-hour for electricity used in any month equivalent to or less than the first 3 kw.-hr. per room.
- 6 cts. per kilowatt-hour for additional electricity used in the month equivalent to or less than the next 3 kw.-hr. per room.
- 3 cts. per kilowatt-hour for all electricity used in the month in excess of the equivalent of the first 6 kw.-hr. per room.

Each portion of the foregoing rate includes 0.15 ct. per kilowatt-hour for lamp service. Such lamp service is optional with the customer. Where the customer elects not to take lamp service, the first, second, and third portions of the rate are, respectively, 7.85 cts., 5.85 cts., and 2.85 cts.

The rates herein stated are the present legal rates of this company as on file with the Commerce Commission, and are subject to change by order of said commission.

Determination of Number of Rooms.—The number of rooms counted in determining the charges hereunder shall be determined by the company in accordance with the Real Estate Board's ordinary method of rating the number of rooms in a house or an apartment, that is to say, all rooms are counted except halls, closets, pantries, corridors, sun porches, alcoves, unfinished attics, bathrooms, lavatories, and toilets; and also except furnace rooms and laundry rooms if in basements; and also except attached private garages with a capacity not exceeding two cars. If a private garage be in a separate building on the premises, and be connected to the residence meter, its room or rooms shall be counted only in case and to the extent that it has a capacity of more than two cars, and one room shall be counted for each additional two-car capacity. Rooms for servants shall be counted in determining the number of rooms hereunder. All rooms in residences, not within the exceptions above mentioned, shall be counted whether wired for electricity or not.

Monthly Bills. Prompt-payment Discount.—As soon as practicable after the end of each month the company shall render a bill to the customer for the amount due hereunder for such month and the customer agrees to pay such bills within ten days after its date; and if such bill be paid within such ten days, the customer shall be entitled to a discount of 1 cent per kilowatt-hour from that part of any monthly bill represented by charges under the first two portions of the rate.

Minimum Charge.—Fifty cents per month per meter; except that, where electrical cooking equipment, having a total rated capacity in excess of $1\frac{3}{4}$ kw. and not exceeding $7\frac{1}{2}$ kw. is installed, the minimum charge shall be \$2 per month. Where any such equipment has a total rated capacity in excess of $7\frac{1}{2}$ kw., there shall be an additional minimum charge of \$0.33 $\frac{1}{3}$ per month for each kilowatt of such excess.

Lamp Service.—Lamp service will or will not be furnished hereunder by the company in accordance with the election made by the customer in the signing hereof.

Determine the bill for the month of January for the following home

- a. Mr. A has a ten-room house and his meter read 150 kw.-hr. Mr. A receives lamp service and always pays his bill within ten days.
- b. Mr. B has a six-room house and his meter reads 115 kw.-hr. Mr. B does not receive lamp service and does not usually pay his bill within ten days.
- c. Mr. C has a twelve-room house and receives lamp service, has a 3-kw. range, but was away all during January. Meter reading was 1 kw.-hr.
- d. Mr. D has a twelve-room house with a two-story two-car garage. The upper story is a recreation room for his children. He receives lamp service and his meter read 208 kw.-hr. He pays his bill early.
- e. Mr. E has a two-room house. Receives lamp service and pays his bill early. His meter read 10 kw.-hr.

LIST II

Rate Schedules of an Electric Light and Power Corp.

Valuation \$100,000,000 at \$500 per kilowatt of rated station capacity

Station gross revenue = \$20,000,000

Station maximum demand = 180,000 kw.

Four groups of consumers use all the demand and all the energy output of the station as follows:

TABLE LXII.—ALLOCATION OF DEMAND AND ENERGY

Group	Per cent valuation	Per cent gross revenue	Per cent gross revenue chargeable		
			Demand	Energy	Total
Commercial light and power.....	25	30	30	+	70 = 100
Railway.....	12	14	45	+	55 = 100
Residential.....	53	44	70	+	30 = 100
Street lighting.....	10	12	0	+	100 = 100

The railway group has two equal demands, determined from the percentage valuation of Table LXII, which occur during the hours of 5 to 8 A.M. and 4 to 6 P.M. It also has an average of 13,300 kw. distributed over the remaining 14 hr. of the typical day.

The residential group has a maximum demand determined as above for the 2 hr. of the central-station peak (4 to 6 P.M.) and an average of 50,200 kw. for the following 4 hr. (6 to 10 P.M.) and 9,550 kw. throughout the remaining hours of the day.

The loads and their resultant power and energy values for a typical day are given in Table LXIII (maximum demands are underlined). Commercial light and power group 300 days and the others 365 days a year.

TABLE LXIII.—GROUP DAILY LOAD CURVE

Hours	Loads, kw.				Total per day	
	Commercial light and power	Railway	Residen- tial	Street lighting	Kw.	Kw.-hr.
12 M to 2	9,000	.....	9,550	18,000	36,550	73,100
2 to 4	11,250	.....	9,550	18,000	38,800	77,600
4 to 5	24,750	.....	9,550	18,000	52,300	52,300
5 to 6	25,750	21,600	9,550	.....	55,900	55,900
6 to 8	27,000	21,600	9,550	.....	58,150	116,300
8 to 4	31,500	13,300	9,550	.....	54,350	434,800
4 to 6	45,000	21,600	95,400	18,000	180,000	360,000
6 to 8	15,750	13,300	50,200	18,000	97,250	194,500
8 to 10	11,250	13,300	50,200	18,000	92,750	185,500
10 to 12 M.	11,250	13,300	9,550	18,000	52,100	104,200
Kw.-hr.	562,500	294,200	563,500	234,000	.....	1,654,200

1. a. Plot a load graph for the typical day from Table LXIII for each group and for the total central station load.

b. Calculate the energy (in kilowatt-hours) used *per annum* by each group and the total for all groups (300 days for commercial light and power group and 365 days for all others).

2. a. Total gross revenue (all groups) per annum.
 b. Average gross revenue (all groups) per kilowatt-hour.
 c. Gross revenue to be obtained from each group.
 d. Average gross revenue per kilowatt-hour to be obtained from each group.

3. a. Portion of gross revenue (each group) to be chargeable to maximum demand.

b. Average gross revenue per kilowatt of each group, respectively, to be chargeable to maximum demand.

4. a. Gross revenue (all groups) chargeable to energy.
 b. Gross revenue (all groups) chargeable to energy per kilowatt-hour or energy used by all groups.
 c. Portion of (a) which is to be obtained from each group, respectively.

- d. Same as (c) per kilowatt-hour of energy used by each group, respectively.
5. Prepare a Hopkinson rate schedule for the railway group without blocking either portion of the schedule. Assume a diversity factor of 1.2.
6. Prepare a Wright rate schedule for the residential group. Use only two blocks, first of which covers all the demand charges. Assume a diversity factor of 1.3.
7. Prepare a flat-rate schedule for the municipal street lighting upon the assumption that 12,000 1,000-watt lamps and 10,000 lamps of 600-watt rating are to be operated upon the prescribed schedule.

Review Questions

LIST III

1. The fixed charge allocated to a certain group of customers is \$10,000 per month. The energy cost to the same group amounts to \$20,000 per month. The meter reading and billing expense totals \$200 for this group of 1,000 customers. If the group maximum demand is 10,000 kw. at a diversity of 1.2 and there is a monthly energy consumption of 1,000,000 kw.-hr.:
- Prepare a three-part rate schedule for the group.
 - Distinguish between a customer's charge and a minimum charge.
2. The A.B.C. Industries had been paying for their power under rate *A* until Jan. 1, 1935. At that time a new rate schedule *B* went into effect. An average month's consumption for the A.B.C. Industries is 180,000 kw.-hr. at 90 per cent power factor with a maximum demand of 1,000 kw.

Rate A:

Demand Charge:

First 500 kw. of maximum demand at \$2.00 per kilowatt.
 Next 1,000 kw. of maximum demand at \$1.00 per kilowatt.
 All over 1,500 kw. of maximum demand at \$0.50 per kilowatt.

Energy Charge:

First 10,000 kw.-hr. of energy at 2 cts. per kilowatt-hour.
 Next 50,000 kw.-hr. of energy at 1 ct. per kilowatt-hour.
 All over 60,000 kw.-hr. of energy at $\frac{1}{2}$ ct. per kilowatt-hour.

Rate B:

First 30 hr. use of maximum billing demand at 2 cts. per kilowatt-hour.

Remaining energy at 1 ct. per kilowatt-hour.

$$\text{Billing demand} = \frac{0.85}{\text{Actual power factor}} \times \text{maximum demand in kilowatts}$$

- What is the monthly saving to the A.B.C. Industries?
- What type of rate is rate *A*; rate *B*?
- Using the following statistical analysis of an electric light and power company, calculate the values of energy in cents per kilowatt-hour and of

maximum demand in dollars per kilowatt to be used in the Greene* method of allocation of fixed charges:

Fixed charges per year to be allocated.....	\$1,200,000
Summation of maximum demands.....	60,000 kw.
Station maximum demand.....	50,000 kw.
Energy output of station per year (365 days)	220,000,000 kw.-hr.

The following table is for group *A* customers:

Number of customers in group.....	100
Kilowatt-hours consumed by group per month....	3,000,000
Summation maximum demands of group.....	20,000 kw.
Demand costs allocated to this group per month...	\$60,000
Energy costs allocated to this group per month....	\$100,000
Meter and billing overhead for this group per month	\$100

4. Prepare a suitable Doherty three-part rate for group *A*.
5. Prepare a suitable Wright rate for group *A*.
6. Discuss the advantages and disadvantages of the above two rates if:
 - a. Group *A* is made up of industrial customers
 - b. Group *A* is made up of retail commercial customers.

LIST IV

1. Place a circle around the letter T or F according to whether you consider the statement true or false, respectively:

- T F If $ax + by + c =$ monthly bill, with x representing kilowatts of maximum demand and y the kilowatt-hours of energy, the c term is always necessary in a rate schedule.
- T F In this formula the x term is found in all rate schedules.
- T F The a term represents hours in the Wright rate schedule.
- T F The number of rooms in a house is often used as a measure of maximum demand for electrical power.
- T F A flat rate is equitable in cases in which the power and hours of use are fixed.
- T F A diversity factor less than unity is possible.
- T F A coal clause in a rate schedule which omits the B.t.u. content of coal may effect results contrary to those intended.
- T F The residential consumer usually has a higher load factor than the office building.
- T F A Doherty rate has only two parts.
- T F A Wright rate may be expressed either as 30 or 60 hr. use of maximum demand.

2. Place a circle around the letter T or F in front of the following statements according to whether you consider each of them to be true or false, respectively:

- T F A maximum demand charge of \$25 per horsepower-year is a reasonable portion of a Hopkinson rate schedule.
- T F A power-factor clause should apply to maximum demand rather than to energy discounts.

* See Chap. XVIII.

- T F Ten dollars per lamp year is a reasonable flat rate for a 1,000-watt street lamp on a 4,000-hr. schedule.
- T F A Wright rate schedule, all of which is expressed in kilowatt-hours, is a two-part rate.
- T F In a blocked-rate schedule it is possible to obtain a reduced monthly bill by wasting energy.
- T F The addition of a minimum charge clause to a Hopkinson rate schedule makes it a Doherty rate schedule.
- T F The same watt-hour meter that is used to measure energy may be fitted with an attachment to measure block-interval maximum demand.
- T F A coal clause usually operates on the demand portion of the rate schedule.
- T F It is not necessary to know or to assume a diversity factor in preparing a Hopkinson rate as long as the group maximum demand is known.
- T F A street-lighting rate is a good example of a flat rate.

3. Place a circle around the letter T or F in front of the following statements according to whether you consider each of them to be true or false, respectively:

- T F Larger B.t.u. content of coal justifies a larger charge per kilowatt-hour for energy.
- T F A power-factor clause, as usually applied, is based on "standard" power factor in such a way that a customer's bill is decreased or increased in accordance with his ability to maintain his power factor above or below the "standard."
- T F The time at which a customer's maximum demand occurs may be obtained readily without the use of a graphical demand meter.
- T F Since all blocks and parts of a Wright rate are expressed in kilowatt-hours, it is a single charge rate.
- T F A customer charge and a minimum charge are one and the same thing.
- T F A power-factor clause in a rate schedule customarily operates to raise or lower the actual demand for billing purposes.
- T F The relatively large proportion of demand costs causes the rate per kilowatt-hour for residential service to be high.
- T F In some instances a flat unmetered rate is a fair method of charging for service.
- T F To promote effectively an off-peak residential rate schedule, it is necessary to have a meter associated with a time switch.
- T F Quantity discounts are obtained in rate schedules by the blocking process.

APPENDIX A

CERTIFICATE OF INCORPORATION OF THE NEVERFAIL CIGARETTE LIGHTER, INC.*

We, the undersigned, all being of full age and two-thirds being citizens of the United States and one of us a resident of the State of † New York , for the purpose of forming a corporation under the Business Corporation Law of the State of New York , do hereby certify and set forth:

First.—The name of said corporation shall be Neverfail Cigarette Lighter, Inc.

Second.—The purposes for which said corporation is to be formed are as follows:

(a) To manufacture, buy, sell, import, export, and generally deal in cigar and cigarette lighters of all kinds and descriptions.

Third.—The amount of capital stock of said corporation shall be Five Hundred Thousand Dollars , all common stock.

Fourth.—The number of shares of which said capital stock is to consist shall be 10,000 shares of the par value of Fifty dollars each.

Fifth.—The principal office of the corporation shall be 4567 Main Street in the City of Buffalo, County of Erie, and State of New York.

Sixth.—The duration of said corporation shall be perpetual.

Seventh.—The number of directors of said corporation shall be three.

Eighth.—The names and post-office addresses of the directors for the first year are as follows:

NAMES	ADDRESSES
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Ninth.—The names and post-office addresses of the subscribers to this certificate and the number of shares which each agrees to take in said corporation are as follows:

NAMES	ADDRESSES	SHARES
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Tenth.—At all elections of directors of this corporation, each stockholder shall be entitled to as many votes as shall equal the number of his shares of stock, multiplied by the number of directors to be elected, and he may cast

* TIPPETTS, CHARLES S., and SHAW, LIVERMORE, "Business Organization and Control," D. V^e Nostrand Company, Inc., New York, 1932.

† Spaces in standard form are filled in for each corporation.

all of such votes for a single director or may distribute them among the number to be voted for, or any two or more of them as he may see fit.

In witness whereof, we have made and signed this Certificate in duplicate, this 30th day of January in the year One Thousand Nine Hundred and Forty

(Signatures)

Most certificates of incorporation are much longer and more detailed than the one just given. It would usually be impossible to form a corporation that gave less information than this one does, with the exception that the names of the original directors are not always required. However most corporation charters will have clauses similar to this one and where they are longer it will be found that they have merely included more detail under each one of the main headings.

AMENDED CERTIFICATE OF INCORPORATION OF UNITED STATES STEEL CORPORATION*

We, the undersigned, in order to form a corporation for the purposes hereinafter stated, under and pursuant to the provisions of the Act of the Legislature of the State of New Jersey, entitled "An Act concerning corporations (Revision of 1896)," and the acts amendatory thereof and supplemental thereto, do hereby certify as follows:

I. The name of the corporation is

United States Steel Corporation

II. The location of its principal office in the State of New Jersey is at No. 51 Newark Street, in the City of Hoboken, County of Hudson. The name of the agent therein and in charge thereof, upon whom process against the corporation may be served, is Hudson Trust Company. Said office is to be the registered office of said corporation.

III. The objects for which the corporation is formed are:

To manufacture iron, steel, manganese, coke, copper, lumber and other materials, and all or any articles consisting, or partly consisting of iron, steel, copper, wood or other materials, and all or any products thereof.

To acquire, own, lease, occupy, use or develop any lands containing coal or iron, manganese, stone or other ores, or oil, and any wood lands, or other lands for any purpose of the Company.

To mine, or otherwise to extract or remove, coal, ores, stone and other minerals and timber from any lands owned, acquired, leased or occupied by the company, or from any other lands.

To buy and sell, or otherwise to deal or to traffic in, iron, steel, manganese, copper, stone, ores, coal, coke, wood, lumber and other materials, and any of the products thereof, and any articles consisting, or partly consisting thereof.

* GERSTENBERG, C. W., "Materials of Corporation Finance," Prentice-Hall, Inc., New York.

To construct bridges, buildings, machinery, ships, boats, engines, cars and other equipment, railroads, docks, slips, elevators, water works, gas works and electric works, viaducts, aqueducts, canals and other water-ways, and any other means of transportation, and to sell the same, or otherwise to dispose thereof, or to maintain and operate the same, except that the Company shall not maintain or operate any railroad or canal in the State of New Jersey.

To apply for, obtain, register, purchase, lease, or otherwise to acquire, and to hold, use, own, operate and introduce, and to sell, assign, or otherwise to dispose of, any trade-marks, trade names, patents, inventions, improvements and processes used in connection with, or secured under letters patent of the United States, or elsewhere, or otherwise; and to use, exercise, develop, grant licenses in respect of, or otherwise to turn to account any such trade-marks, patents, licenses, processes, and the like, or any such property or rights.

To engage in any other manufacturing, mining, construction or transportation business of any kind or character whatsoever, and to that end to acquire, hold, own and dispose of any and all property, assets, stocks, bonds and rights of any and every kind; but not to engage in any business hereunder which shall require the exercise of the right of eminent domain within the State of New Jersey.

To acquire by purchase, subscription or otherwise, and to hold or to dispose of, stocks, bonds or any other obligations of any corporation formed for, or then or theretofore engaged in or pursuing, any one or more of the kinds of business, purposes, objects or operations above indicated, or owning or holding any property of any kind herein mentioned; or of any corporation owning or holding the stocks or the obligations of any such corporation.

To hold for investment, or otherwise to use, sell or dispose of, any stock, bonds or other obligations of any such other corporation; to aid in any manner any corporation whose stock, bonds or other obligations are held or are in any manner guaranteed by the Company and to do any other acts or things for the preservation, protection, improvement or enhancement of the value of any such stock, bonds or other obligations, or to do any acts or things designed for any such purpose; and, while owner of any such stock, bonds or other obligations, to exercise all the rights, powers and privileges of ownership thereof, and to exercise any and all voting power thereon.

The business or purpose of the Company is from time to time to do any one or more of the acts and things herein set forth; and it may conduct its business in other States and in the Territories and in foreign countries, and may have one office or more than one office, and keep the books of the Company outside of the State of New Jersey, except as otherwise may be provided by law; and may hold, purchase, mortgage and convey real and personal property either in or out of the State of New Jersey.

Without in any particular limiting any of the objects and powers of the corporation, it is hereby expressly declared and provided that the corporation shall have power to issue bonds and other obligations, in payment for property purchased or acquired by it, or for any object in or

about its business; to mortgage or pledge any stocks, bonds or other obligations, or any property which may be acquired by it, to secure any bonds or other obligations by it issued or incurred; to guarantee any dividends or bonds or contracts or other obligations; to make and perform contracts of any kind and description; and in carrying on its business, or for the purpose of attaining or furthering any of its objects, to do any and all other acts and things, and to exercise any and all other powers which a co-partnership or natural person could do and exercise, and which now or hereafter may be authorized by law.

IV. The total authorized capital stock of the corporation is eleven hundred million dollars (\$1,100,000,000), divided into eleven million shares of the par value of one hundred dollars each. Of such total authorized capital stock, five million five hundred thousand shares, amounting to five hundred and fifty million dollars, shall be preferred stock, and five million five hundred thousand shares, amounting to five hundred and fifty million dollars, shall be common stock.

From time to time, the preferred stock and the common stock may be increased according to law, and may be issued in such amounts and proportions as shall be determined by the board of directors, and as may be permitted by law.

The holders of the preferred stock shall be entitled to receive when and as declared, from the surplus or net profits of the corporation, yearly dividends at the rate of seven per centum per annum, and no more, payable quarterly on dates to be fixed by the by-laws. The dividends on the preferred stock shall be cumulative, and shall be payable before any dividend on the common stock shall be paid or set apart; so that, if any year dividends amounting to seven per cent shall not have been paid thereon, the deficiency shall be payable before any dividends shall be paid upon or set apart for the common stock.

Whenever all cumulative dividends on the preferred stock for all previous years shall have been declared and shall have become payable, and the accrued quarterly installments for the current year shall have been declared, and the company shall have paid such cumulative dividends for previous years and such accrued quarterly installments, or shall have set aside from its surplus or net profits a sum sufficient for the payment thereof, the Board of Directors may declare dividends on the common stock, payable then or thereafter, out of any remaining surplus or net profits.

In the event of any liquidation or dissolution or winding up (whether voluntary or involuntary) of the corporation, the holders of the preferred stock shall be entitled to be paid in full both the par amount of their shares, and the unpaid dividends accrued thereon before any amount shall be paid to the holders of the common stock; and after the payment to the holders of the preferred stock of its par value, and the unpaid accrued dividends thereon, the remaining assets and funds shall be divided and paid to the holders of the common stock according to their respective shares.

V. The names and post-office addresses of the incorporators, and the number of shares of stock for which severally and respectively we do hereby subscribe (the aggregate of our said subscriptions, being three thousand

dollars, is the amount of capital stock with which the corporation will commence business), are as follows:

Name	Post-office address	Number of shares	
		Preferred stock	Common stock
Charles C. Cluff.....	51 Newark Street, Hoboken, New Jersey	5	5
William J. Curtis. . . .	51 Newark Street, Hoboken, New Jersey	5	5
Charles MacVeagh. . .	51 Newark Street, Hoboken, New Jersey	5	5

V1. The duration of the corporation shall be perpetual.

VII. The number of the directors of the Company shall be fixed from time to time by the by-laws; but the number, if fixed at more than three, shall be some multiple of three. The directors shall be classified with respect to the time for which they shall severally hold office by dividing them into three classes, each consisting of one-third of the whole number of the board of directors. The directors of the first class shall be elected for a term of one year; the directors of the second class for a term of two years; and the directors of the third class for a term of three years; and at each annual election the successors to the class of directors whose terms shall expire in that year shall be elected to hold office for the term of three years, so that the term of office of one class of directors shall expire in each year.

The number of the directors may be increased as may be provided in the by-laws. In case of any increase of the number of the directors the additional directors shall be elected as may be provided in the by-laws, by the Directors or by the stockholders at an annual or special meeting and one-third of their number shall be elected for the then unexpired portion of the term of the directors of the first class, one-third of their number for the unexpired portion of the term of the directors of the second class, and one-third of their number for the unexpired portion of the term of the directors of the third class, so that each class of directors shall be increased equally.

In case of any vacancy in any class of directors through death, resignation, disqualification or other cause, the remaining directors, by affirmative vote of a majority of the Board of Directors, may elect a successor to hold office for the unexpired portion of the term of the director whose place shall be vacant, and until the election of a successor.

The Board of Directors shall have power to hold their meetings outside of the State of New Jersey at such places as from time to time may be designated by the by-laws or by resolution of the Board. The by-laws may prescribe the number of directors necessary to constitute a quorum of the Board of Directors, which number may be less than a majority of the whole number of the directors.

Unless authorized by votes given in person or by proxy by stockholders holding at least two-thirds of the capital stock of the corporation, which is represented and voted upon in person or by proxy at a meeting specially called for that purpose or at an annual meeting, the Board of Directors shall not mortgage or pledge any of its real property, or any shares of the capital stock of any other corporation; but this prohibition shall not be construed to apply to the execution of any purchase-money mortgage or any other purchase-money lien. As authorized by the Act of the Legislature of the State of New Jersey passed March 22, 1901, amending the 17th section of the Act Concerning Corporations (Revision of 1896), any action which theretofore required the consent of the holders of two-thirds of the stock at any meeting after notice to them given, or required their consent in writing to be filed, may be taken upon the consent of, and the consent given and filed by the holders of two-thirds of the stock of each class represented at such meeting in person or by proxy.

Any officer elected or appointed by the Board of Directors may be removed at any time by the affirmative vote of a majority of the whole Board of Directors. Any other officer or employee of the Company may be removed at any time by vote of the Board of Directors, or by any committee or superior officer upon whom such power of removal may be conferred by the by-laws or by vote of the Board of Directors.

The Board of Directors, by the affirmative vote of a majority of the whole board, may appoint from the directors an executive committee, of which a majority shall constitute a quorum; and to such extent as shall be provided in the by-laws, such committee shall have and may exercise all or any of the powers of the Board of Directors, including power to cause the seal of the corporation to be affixed to all papers that may require it.

The Board of Directors, by the affirmative vote of a majority of the whole board, may appoint any other Standing Committees, and such Standing Committees shall have and may exercise such powers as shall be conferred or authorized by the by-laws.

The Board of Directors may appoint not only other officers of the Company, but also one or more vice-presidents, one or more assistant treasurers and one or more assistant secretaries; and, to the extent provided in the by-laws, the persons so appointed respectively shall have and may exercise all the powers of the president, of the treasurer and of the secretary, respectively.

The Board of Directors shall have power from time to time to fix and to determine and to vary the amount of the working capital of the Company; and to direct and determine the use and disposition of any surplus or net profits over and above the capital stock paid in; and in its discretion the Board of Directors may use and apply any such surplus or accumulated profits in purchasing or acquiring its bonds or other obligations, or shares of its own capital stock, to such extent and in such manner and upon such terms as the Board of Directors shall deem expedient; but shares of such capital stock so purchased or acquired may be resold, unless such shares shall have been retired for the purpose of decreasing the Company's capital stock as provided by law.

The Board of Directors from time to time shall determine whether and to what extent, and at what times and places and under what conditions and regulations, the accounts and books of the corporation or any of them, shall be open to the inspection of the Stockholders, and no Stockholder shall have any right to inspect any account or book or document of the corporation, except as conferred by Statute or authorized by the Board of Directors, or by a resolution of the Stockholders.

Subject always to by-laws made by the Stockholders, the Board of Directors may make by-laws, and, from time to time, may alter, amend or repeal any by-laws; but any by-laws made by the Board of Directors may be altered or repealed by the Stockholders at any annual meeting, or at any special meeting, provided notice of such proposed alteration or repeal be included in the notice of the meeting.

IN WITNESS WHEREOF, we have hereunto set our hands and seals the 23rd day of February, 1901.

Charles C. Cluff (Seal)
William J. Curtis (Seal)
Charles MacVeagh (Seal)

Signed, sealed and delivered }
in the presence of }

Francis Lynde Stetson
Victor Morawetz.
State of New Jersey } ss.:
County of Hudson }

Be it remembered that on this 23rd day of February, 1901, before the undersigned, personally appeared Charles C. Cluff, William J. Curtis and Charles MacVeagh, who, I am satisfied, are the persons named in and who executed the foregoing certificate; and I having first made known to them, and to each of them, the contents thereof, they did each acknowledge that they signed, sealed and delivered the same as their voluntary act and deed.

Geo. Holmes,
Master in Chancery of New Jersey

10ct. Internal Revenue Stamp Cancelled.
ENDORSED "Received in the Hudson Co. N. J. Clerk's Office Feb'y 25th
A.D. 1901 and Recorded in Clerk's record No. ____ on Page ____

Maurice J. Stack,
Clerk"

ENDORSED "Filed Feb. 25, 1901

George Wurts,
Secretary of State."

APPENDIX B

BY-LAWS OF THE MAYSWOOD MOTOR COMPANY NEW YORK CITY*

Article I. Stock

1. Certificates of Stock shall be issued in numerical order from the stock certificate book to each stockholder of record whose stock has been paid in full, be signed by the President and Treasurer, and be sealed by the Secretary with the corporate seal. A record of each certificate issued shall be kept on the stub thereof.

2. Transfers of Stock shall be made only upon the books of the Company, and before a new certificate is issued the old certificate must be surrendered for cancellation. The stock books of the Company shall be closed for transfer twenty days before general elections and ten days before dividend days.

3. The Treasury Stock of the Company shall consist of such issued and outstanding stock of the Company as may be donated to the Company or otherwise acquired, and shall be held subject to disposal by the Board of Directors. Such stock shall neither vote nor participate in dividends while held by the Company.

Article II. Stockholders

1. The Annual Meeting of the stockholders of this Company shall be held in the principal office of the Company, in New York City, on the second Monday in January of each year, at 3 P.M. if not a legal holiday, but if a legal holiday, then on the next business day following.

2. Special Meetings of the stockholders may be called at the principal office of the Company at any time by resolution of the Board of Directors, or upon written request of stockholders holding one-third of the outstanding stock.

3. Notice of Meetings, written or printed, shall be prepared and mailed to the last known post-office address of each stockholder not less than ten days before any regular or special meeting of stockholders, and if for a special meeting, such notice shall state the object or objects thereof. No failure of or irregularity of notice of any regular meeting shall invalidate such meeting or any proceeding thereat.

4. A Quorum at any meeting of the stockholders shall consist of a majority of the voting stock of the Company, represented in person or by proxy. A majority of such quorum shall decide any question that may come before the meeting.

* CONYNGTON, THOMAS, R. J. BENNETT, and PAUL W. PINKERTON,
"Corporation Procedure," Ronald Press Company, New York.

5. The Election of Directors shall be held at the annual meeting of stockholders, and shall, after the first election, be conducted by two inspectors of election, appointed by the President for that purpose. The election shall be by ballot and each stockholder of record shall be entitled to cast one vote for each share of stock held by him.

6. The Order of Business at the annual meeting, and, as far as possible, at all other meetings of the stockholders, shall be:

1. Calling of roll.
2. Proof of due notice of meeting.
3. Reading and disposal of any unapproved minutes.
4. Annual reports of officers and committees.
5. Election of directors.
6. Unfinished business.
7. New business.
8. Adjournment.

Article III. Directors

1. The Business and Property of the Company shall be managed by a Board of five directors, who shall be stockholders of the Company and who shall be elected annually by ballot by the stockholders for the term of one year, and shall serve until the election and acceptance of their duly qualified successors. Any vacancies may be filled by the Board for the unexpired term. Directors shall receive no compensation for their services as such.

2. The Regular Meetings of the Board of Directors shall be held in the principal office of the Company in New York City on the third Tuesday of each month, at 3 P.M. if not a legal holiday, but if a legal holiday, then on the next business day following.

3. Special Meetings of the Board of Directors may be held in the principal office of the Company in New York City at any time on call of the President, or of any three members of the Board, or may be held at any time and place without notice, by unanimous written consent of all the members, or with the presence and participation of all members at such meeting.

4. Notices of both regular and special meetings, save when held by unanimous consent or participation, shall be mailed by the Secretary to each member of the Board not less than five days before any such meeting and notices of special meetings shall state the purposes thereof. No failure or irregularity of notice of any regular meeting shall invalidate such meeting or any proceeding thereat.

5. A Quorum at any meeting shall consist of a majority of the entire membership of the Board. A majority of such quorum shall decide any question that may come before the meeting.

6. Officers of the Company shall be elected by ballot by the Board of Directors at their first meeting after the election of Directors each year. If any office becomes vacant during the year, the Board of Directors shall fill the same for the unexpired term. The Board of Directors shall fix the compensation of the officers and agents of the Company.

7. The Order of Business at any regular or special meeting of the Board of Directors shall be:

1. Reading and disposal of any unapproved minutes.
2. Reports of officers and committees.
3. Unfinished business.
4. New business.
5. Adjournment.

Article IV. Officers

1. **The Officers of the Company** shall be a President, a Vice-president, a Secretary, and a Treasurer, who shall be elected for one year and shall hold office until their successors are elected and qualify. The position of Secretary and Treasurer may be united in one person.

2. **The President** shall preside at all meetings, shall have general supervision of the affairs of the Company, shall sign or countersign all certificates of stock, contracts, and other instruments of the Company authorized by the Board of Directors, except as otherwise directed by the board; shall make such reports to the Directors and stockholders as he may deem necessary or as may be required of him, and perform all such other duties as are incident to his office or are properly required of him by the Board of Directors. In the absence or disability of the President, the Vice-president shall exercise all his functions.

3. **The Secretary** shall issue notices for all meetings of stockholders and directors, shall keep their minutes, shall have charge of the seal and the corporate books, shall sign, with the President, such instruments as require such signature, and shall make such reports and perform such other duties as are incident to his office, or are properly required of him by the Board of Directors.

4. **The Treasurer** shall have the custody of all moneys and securities of the Company and shall keep regular books of account and balance the same each month. He shall sign or countersign such instruments as require his signature, shall perform all duties incident to his office or that are properly required of him by the Board, and shall give bond for the faithful performance of his duties in such sum and with such sureties as may be required by the Board of Directors.

Article V. Dividends and Finance

1. **Dividends** shall be declared from the surplus profits of the Company at such times as the Board of Directors shall direct, and no dividend shall be declared that will impair the capital of the Company.

2. **The Moneys** of the Company shall be deposited in the name of the Company in such banks or trust companies as the Board of Directors shall designate, and shall be drawn out only by check signed by the Treasurer and countersigned by the President.

Article VI. Seal

1. **The Corporate Seal** of the Company shall consist of two concentric circles between which is the name of the Company, and in the centre shall be inscribed "Incorporated 1922, New York," and such seal, as impressed on the margin hereof, shall be the Corporate Seal of the Company.

Article VII. Amendments

1. These By-laws may be amended, repealed, or altered, in whole or in part, by a majority vote of the entire outstanding stock of the Company, at any regular meeting of the stockholders, or at any special meeting where such action has been announced in the call and notice of such meeting.

2. The Board of Directors shall not alter or repeal any by-laws adopted by the stockholders of the Company, but may adopt additional by-laws in harmony therewith.

BY-LAWS OF THE OGDEN IRON AND STEEL COMPANY*

Incorporated under the Laws of New Jersey

Article I. Stock

Sec. 1. Certificates of Stock.—Each stockholder of the company whose stock has been paid for in full shall be entitled to a certificate or certificates showing the amount of stock of the Company standing on the books in his name. Each certificate shall be numbered, bear the signatures of the President and Treasurer and the seal of the Company, and be issued in numerical order from the stock certificate book. A full record of each certificate of stock, as issued, shall be entered on the corresponding stub of the stock certificate book.

Sec. 2. Transfers of Stock.—Transfers of stock shall be made upon the proper stock books of the Company, and must be accompanied by the surrender of the duly indorsed certificate or certificates representing the transferred stock. Surrendered certificates shall be canceled and attached to the corresponding stubs in the stock certificate book and new certificates issued to the parties entitled thereto. The stock books shall be closed to transfers twenty days before general elections and twenty days before dividend days.

Sec. 3. Lost Certificates.—The Board of Directors may order a new certificate or certificates of stock to be issued in the place of any certificate or certificates of the Company alleged to have been lost or destroyed, but in every such case the owner of the lost certificate or certificates shall first cause to be given to the Company a bond in such sum, not less than the par value of such lost or destroyed certificate or certificates of stock, as said Board may direct, as indemnity against any loss that the Company may incur by reason of such replacement of the lost certificate or certificates; but the Board of Directors may, in their discretion, refuse to replace any lost certificate of stock, save upon the order of some court having jurisdiction in such matter.

Sec. 4. Stock and Transfer Books.—The stock and transfer books of the Company shall be kept in its principal office, No. 525 Main Street, East Orange, New Jersey, and shall be open during business hours to the inspec-

* CONYNGTON, THOMAS, R. J. BENNETT, and PAUL W. PINKERTON, "Corporation Procedure," Ronald Press Company, New York.

tion of any stockholder of the Company. All other books and records of the Company shall be kept in its office in New York City, and shall include a stock book, which shall be open during business hours to the inspection of any stockholder or judgment creditor of the Company.

Sec. 5. Preferred Stock.—The capital stock of this Company shall be One Hundred Thousand Dollars (\$100,000), consisting of One Thousand (1,000) Shares, each of the par value of One Hundred Dollars (\$100), and of these, Five Hundred (500) Shares shall be preferred stock, and Five Hundred (500) Shares shall be common stock.

The said preferred stock of the Company shall receive from its net earnings a Six Per cent (6%) annual cumulative dividend before any dividends are paid upon the common stock, but the holders of preferred stock shall not be entitled to vote at the meetings of the stockholders of the Company.

Sec. 6. Treasury Stock.—All issued and outstanding stock of the Company that may be donated to or be purchased by the Company shall be termed treasury stock, and shall be held subject to disposal by action of the Board of Directors. Such stock shall neither vote nor participate in dividends while held by the Company.

Article II. Stockholders

Sec. 1. Annual Meetings.—The regular annual meetings of the stockholders shall be held in the office of the Company, at No. 525 Main Street, East Orange, New Jersey, at 11 A.M., on the second Monday of January in each year if not a legal holiday, but if a legal holiday, then on the next business day following. At this meeting the Directors for the ensuing year shall be elected, the officers of the Company shall present their annual reports, and the Secretary shall have on file, for inspection and reference, an alphabetical list of the stockholders of the Company, giving the amount of stock held by each, as shown by the stock books twenty days before the date of such annual meeting.

Sec. 2. Special Meetings.—Special meetings of the stockholders may be held at any time, in the office of the Company, pursuant to a resolution of the Board of Directors, or to a call signed by stockholders holding a majority of the voting stock of the Company. Calls for special meetings shall specify the time, place, and object or objects thereof, and no other business than that specified in the call shall be considered at any such meeting.

Sec. 3. Notice of Meetings.—A written or printed notice of every regular or special meeting of the stockholders, stating the time and the place, and, in case of special meetings, the objects thereof, shall be prepared and mailed by the Secretary, postage prepaid, to the last known post-office address of each stockholder, at least ten days before the date of any such meeting. No failure or irregularity of notice of any regular meeting shall invalidate the same or any proceeding thereat.

Sec. 4. Voting.—Only stockholders of record of the common stock of the Company shall be entitled to vote at the regular and special meetings of stockholders. At such meetings each stockholder shall be entitled to one vote for each share of stock standing on the books of the Company in his name.

Sec. 5. Election of Directors.—At the first meeting of the stockholders and at each annual meeting of the stockholders thereafter, a Board of seven Directors shall be elected, who shall serve until the election and acceptance of their duly qualified successors. All elections for Directors shall be by ballot, and the candidates, to the number to be elected, receiving the highest number of votes, shall be declared elected.

If for any reason Directors are not elected at the annual meeting of stockholders, a special meeting shall be called for the purpose within thirty days thereafter, at which Directors shall be elected in all respects as at the annual meeting.

Two inspectors of election shall be appointed by the President to conduct the election of Directors to serve for the ensuing year. These inspectors shall be sworn to the faithful discharge of their duty and shall then take charge of the election. No person who is a candidate for the office of Director shall act as an inspector of election.

Sec. 6. Quorum.—A majority of the outstanding stock, exclusive of treasury stock, shall be necessary to constitute a quorum at meetings of stockholders. When a quorum is present at any meeting, a majority of the stock represented thereat shall decide any question brought before such meeting. In the absence of a quorum those present may adjourn the meeting from day to day, but until a quorum is secured no business may be transacted.

Sec. 7. Proxies.—Any stockholder entitled to vote may be represented at any regular or special meeting of stockholders by a duly executed proxy. Proxies shall be in writing and properly signed, but shall require no other attestation. No proxy shall be recognized unless executed within eleven months of the date of the meeting at which it is presented.

Sec. 8. Officers of Meetings.—The President, if present, shall preside at all meetings of the stockholders. In his absence, the next officer in due order who may be present shall preside. For the purposes of these by-laws, the due order of officers shall be as follows: President, Vice-president, Treasurer, and Secretary.

The Secretary of the Company shall keep a faithful record of the proceedings of all stockholders' meetings.

Sec. 9. Order of Business.—The order of business at the annual meeting, and, so far as practicable, at all other meetings of the stockholders, shall be as follows:

1. Calling of roll.
2. Proof of due notice of meeting.
3. Reading and disposal of any unapproved minutes.
4. Annual reports of officers and committees.
5. Election of directors.
6. Unfinished business.
7. New business.
8. Adjournment.

Article III. Directors

Sec. 1. Number and Authority.—A Board of seven Directors shall be elected, who shall have entire charge of the property, interests, business, and

transactions of the Company, with full power and authority to manage and conduct the same.

Sec. 2. Qualifications.—No person shall be elected, nor shall be competent to act as a Director of this Company, unless he is at the time of election the holder of record of at least one share of its stock. At least one of the Directors of the Company must be resident in the State of New Jersey.

Sec. 3. Vacancies.—Any vacancy occurring in the Board of Directors may be filled for the unexpired term by a majority vote of the remaining members. In event of the membership of the Board falling below the number necessary for a quorum, a special meeting of the stockholders shall be called and such number of Directors shall be elected thereat as may be necessary to restore the membership of the Board to its full number.

Sec. 4. Regular Meetings.—The regular meetings of the Board of Directors shall be held in the office of the Company, in the City of New York, at 3 p.m., on the second Monday of each month if not a legal holiday, but if a legal holiday, then on the next business day following.

Sec. 5. Special Meetings.—Special meetings of the Board of Directors may be held at any time, in the office of the Company in the City of New York, on the written call of the President or of any three members of the Board. Special meetings may be held at any time and place and without notice, by unanimous consent of the Board.

Sec. 6. Notice of Meetings.—The Secretary shall notify each member of the Board of all regular or special meetings, by mailing to each member's last known post-office address, postage prepaid, at least five days before any such meeting, a written or printed notice thereof, giving the time, place, and, in case of special meetings, the objects thereof, and no other business shall be considered at any special meeting than shall have been so notified to the members. No failure or irregularity of notice of any regular meeting shall invalidate the same or any proceeding thereat.

Sec. 7. Quorum.—A majority of the Board of Directors shall constitute a quorum, and a majority of the members in attendance at any Board meeting shall, in the presence of a quorum, decide its action. A minority of the Board present at any regular or special meeting may, in the absence of a quorum, adjourn to a later date, but may not transact any business.

Sec. 8. Election of Officers.—At the first meeting of the Board of Directors after the election of Directors each year, a President, Vice-president, Secretary, Treasurer, and General Manager shall be elected to serve for the ensuing year and until the election of their respective successors. Election shall be by ballot, and a majority of the votes cast shall be necessary to elect. If not detrimental to the business or operations of the Company, any two offices may be conferred upon one person. The Directors shall fix the compensation of officers subject to any limitations of the Charter and the By-laws. Any vacancies that occur may be filled by the Board for the unexpired term. The Board shall have the right to remove any officer for cause by a two-thirds vote of the entire membership of the Board.

Sec. 9. Compensation of Directors.—Each Director shall receive the sum of five dollars for his attendance at any regular or special meeting of the

Board of Directors, but shall receive no other salary or compensation for his services as a Director of the Company.

Sec. 10. Power to Pass By-laws.—The Board of Directors shall have no power to amend, alter, or repeal by-laws adopted by the stockholders of the Company, but may pass such additional by-laws in conformity therewith as may be necessary or convenient to facilitate the business of the Company.

Sec. 11. Executive Committee.—The President, Vice-president, and Treasurer shall together constitute an Executive Committee, which shall be a part of the permanent executive organization of the Company, and shall, in the interim between meetings of the Board of Directors, exercise all the powers of that body, in accordance with the general policy of the Company and the directions of the Board.

Meetings of the Executive Committee shall be held on call of the President, or of any two members of the Committee. All of the members of the Committee must be duly notified of meetings, and a majority of the members shall constitute a quorum. The Executive Committee shall keep a record of all meetings and actions of the Committee, and such records shall at all times be open to the inspection of any Director.

Sec. 12. Corporation Offices.—The principal office of the Company within the State of New Jersey shall be at 525 Main street, East Orange, and the agent therein and in charge thereof upon whom process may be served shall be the Registration Trust Company of New Jersey. An office shall also be maintained in New York City, and such other offices for the transaction of its business shall be maintained at such other places in or outside of the State of New Jersey, as may be determined upon by the Board of Directors.

Sec. 13. Order of Business.—The regular order of business at meetings of the Board of Directors shall be as follows:

1. Reading and disposal of any unapproved minutes.
2. Reports of officers and committees.
3. Unfinished business.
4. New business.
5. Adjournment.

Article IV. Officers

Sec. 1. Enumeration, Election, and Qualification.—The officers of the Company shall be a President, Vice-president, Treasurer, Secretary and General Manager. These officers shall be elected by the Board of Directors at the first regular meeting after the election of directors each year, and shall hold office for the term of one year, and until their respective successors are duly elected and qualify. The President and Vice-president shall be elected from the Directors of the Company.

Sec. 2. The President.—The President, when present, shall preside at all meetings of the stockholders and of the Board of Directors; shall sign all certificates of stock; shall sign or countersign, as may be necessary, all such bills, notes, checks, contracts, and other instruments as may pertain to the ordinary course of the Company's business; and sign, when duly

authorized thereto, all contracts, orders, deeds, liens, licenses, and other instruments of a special nature.

He may also, in the absence or disability of the Treasurer, indorse checks, drafts, and other negotiable instruments for deposit or collection, and shall, with the Secretary, sign the minutes of all meetings over which he has presided.

At the first regular meeting of the Board in January he shall submit a complete report of the operations of the Company for the preceding year together with a statement of the Company's affairs as existing at the close of the last fiscal year, and shall submit a similar report at the annual meeting of stockholders; also he shall report to the Board of Directors, from time to time, all such matters coming within his notice and relating to the interests of the Company as should be brought to the attention of the Board.

He shall be, ex officio, a member of all standing committees, shall have such usual powers of supervision and management as may pertain to the office of President, and perform such other duties as may be properly required of him by the Board of Directors.

Sec. 3. The Vice-president.—The Vice-president shall familiarize himself with the affairs of the Company, and, in the absence, disability, or refusal to act of the President, shall possess all of the powers and perform all of the duties of that officer.

Sec. 4. The Secretary.—The Secretary shall keep full minutes of all meetings of the stockholders and of the Board of Directors; shall read such minutes at the proper subsequent meeting; shall issue all calls for meetings and notify all officers and directors of their election; shall have charge of and keep the seal of the corporation, and affix the same to certificates of stock when such certificates are signed by the President and Treasurer, and shall affix the seal, attested by his signature, to such other instruments as may require the same.

He shall keep the stock certificate book and the other usual corporation books, and shall prepare, record, transfer, issue, seal, and cancel certificates of stock, as required by the transactions of the Company and its stockholders. He shall also sign with the President all contracts, deeds, licenses, and other instruments when so ordered.

He shall make such reports to the Board of Directors as they may desire, and shall also prepare such reports and statements as are required by the State laws. He shall make out, twenty days before any election of Directors, a complete list of the stockholders entitled to vote at such election, arranged in alphabetical order, and giving the number of shares of stock that may be voted by each, and shall keep the same open to inspection at the office of the Company until the time of and during the said election. He shall allow any stockholder, on application in business hours, to inspect the stock certificate books, the stock transfer book, and the stock ledger.

He shall attend to such correspondence and to such other duties as may be incidental to his office or properly be assigned him by the Board.

He shall receive such salary as may be fixed by the Board of Directors.

Sec. 5. The Treasurer.—The Treasurer shall have the custody of and be responsible for all moneys and securities of the Company; shall keep full and

accurate records and accounts in books belonging to the Company, showing the transactions of the Company, its accounts, liabilities, and financial condition; and shall see that all expenditures are duly authorized and are evidenced by proper receipts and vouchers. He shall deposit, in the name of the Company, in such depositary or depositaries as are approved by the Directors, all moneys that may come into his hands for the Company account. His books and accounts shall be open at all times during business hours to the inspection of any Director of the Company.

The Treasurer shall also indorse for collection or deposit all bills, notes, checks, and other negotiable instruments of the Company; shall pay out money as may be necessary in the transactions of the Company, either by special or general direction of the Board of Directors, and on checks signed by the President and himself, and shall generally, together with the President, have supervision of the finances of the Company.

He shall also make a full report of the financial condition of the Company for the annual meeting of the stockholders, and shall make such other reports and statements as may be required of him by the Board of Directors or by the laws of the State.

He shall give bond in the sum of Five Thousand Dollars, with sureties satisfactory to the Board of Directors, for the faithful performance of his duties and for the restoration to the Company, in event of his death, resignation, or removal from office, of all books, papers, vouchers, money, and other property belonging to the Company that may have come into his custody. He shall receive such compensation as may be fixed by the Board of Directors.

Sec. 6. The General Manager.—The General Manager shall, under the supervision of the Board of Directors and the President, have charge of and manage the active business operations of the Company. He shall perform such further duties and make such reports as may be required of him by the Board of Directors, and shall receive such salary, not exceeding Eight Thousand Dollars per annum, as may be fixed by the Board of Directors.

Article V. Dividends and Finances

Sec. 1. Dividends.—Dividends shall be declared at such times as the Board may direct, but no dividend shall be declared or paid save from surplus profits remaining after all current liabilities of the Company have been fully paid, nor shall any dividend be declared that will impair the capital of the Company.

Sec. 2. Reserve Fund.—No dividend to exceed six per cent per annum shall be declared by the Board of Directors until there shall have been reserved from surplus profits a fund of not less than One Hundred Thousand Dollars, such fund to be designated "Extension Fund" and to be used for the extension or enlargement of the business of the Company and the betterment of its plant, or for such other connected purposes as may be deemed necessary or advisable by the Board of Directors.

Sec. 3. Bank Deposits.—The Treasurer shall deposit the moneys of the Company, as the same may come into his hands, in such depositary or depositaries as may be designated by the Board of Directors, and such

deposits shall be made in the name of the Company, and moneys shall be withdrawn therefrom only by check signed by the Treasurer and countersigned by the President.

Article VI. Sundry Provisions

Sec. 1. Corporate Seal.—The corporate seal of the Company shall consist of two concentric circles, between which shall be the name of the Company, and in the center shall be inscribed "Incorporated 1922, New Jersey," and such seal, as impressed on the margin hereof, is hereby adopted as the corporate seal of the Company.

Sec. 2. Penalties.—Any officer, director, or stockholder who shall disobey or violate any of the provisions of these by-laws shall be fined in an amount not to exceed Twenty Dollars, such fine to be imposed by the Board of Directors, and if not paid at the time, to be deducted from any salary or dividend then due or that may thereafter become due said person.

Sec. 3. Amendment.—These by-laws may be amended, repealed, or altered, in whole or in part, at any regular meeting of the stockholders, or at any special meeting where such action has been duly announced in the call, provided that a majority of the entire voting stock of the Company shall vote for such amendment, repeal, or alteration.

The Board of Directors shall have no power to amend, alter, or repeal the by-laws adopted by the stockholders, but may pass such additional by-laws in conformity therewith as may be necessary or convenient to facilitate the business of the Company.

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